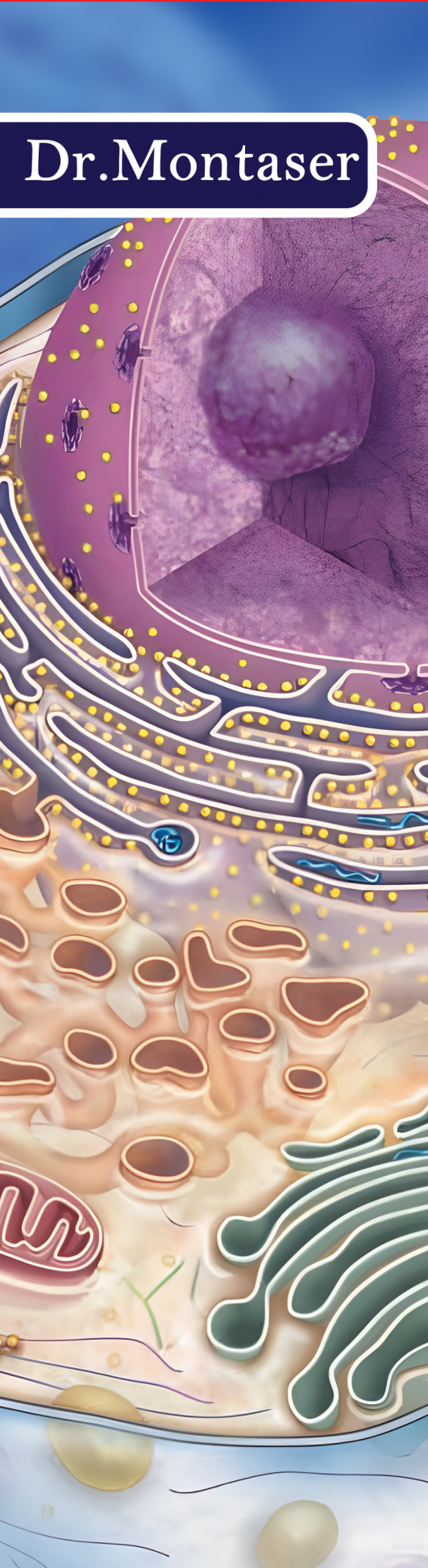


The Complete URT Exam Prep Guide



Dr. Montaser

Reference passages

BIOLOGY
GEOLOGY

URT PREMIER

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Passage (1) :

An active skeletal muscle is said to be fatigued when it can no longer continue to perform at the required level of activity. Many factors are involved in promoting muscle fatigue. For example, muscle fatigue has been correlated with (1) depletion of metabolic reserves within the muscle fibers, (2) damage to the sarcolemma and sarcoplasmic reticulum, (3) a decline in pH within the muscle fibers and the muscle as a whole, decreasing calcium ion binding to troponin and altering enzyme activities, and (4) a sense of weariness and a reduction in the desire to continue the activity, due to the effects of low blood pH and pain on the brain.

Muscle fatigue is cumulative—the effects becomes more pronounced as more neurons and muscle fibers are affected. The result is a gradual reduction in the capabilities and performance of the entire skeletal muscle. If a muscle fiber is contracting at moderate levels and ATP demands can be met through aerobic metabolism, fatigue will not occur until glycogen, lipid, and amino acid reserves are depleted. This type of fatigue affects the muscles of endurance athletes, such as marathon runners, after hours of exertion. When a muscle produces a sudden, intense burst of activity at peak levels, most of the ATP is provided by glycolysis. After just seconds to minutes, the rising lactic acid levels lower the tissue pH, and the muscle can no longer function normally. Sprinters get this type of muscle fatigue.

Normal muscle function requires (1) substantial intracellular energy reserves, (2) a normal circulatory supply, (3) normal blood oxygen levels, and (4) blood pH within normal limits. Anything that interferes with any of these factors will promote premature muscle fatigue, for example, reduced blood flow from tight clothing, heart problems, or blood loss slows the delivery of oxygen and nutrients, accelerates the buildup of lactic acid and promotes muscle fatigue.

Figure (1) :

- a. Resting muscle:** fatty acids are catabolized; the ATP produced is used to build energy reserves of ATP, CP and glycogen.

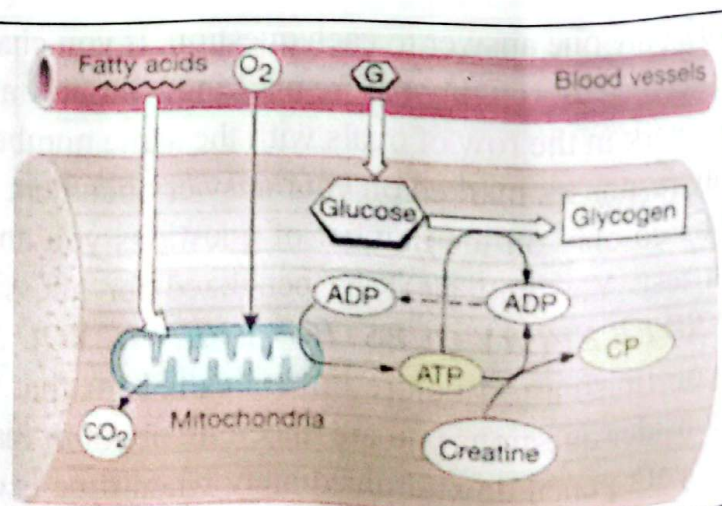


Figure (1) :

- b. Moderate activity:** Glucose and fatty acids are catabolized; the ATP produced is used to power contraction.

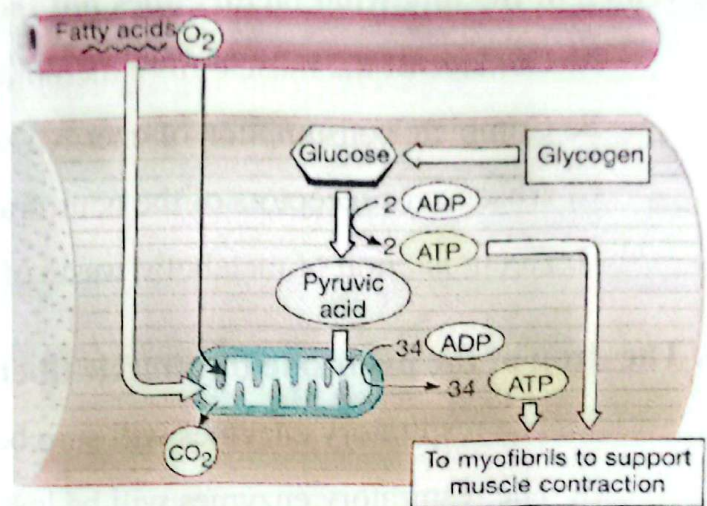


Figure (1) :

- c. Peak activity:** Most ATP is produced through glycolysis with lactic acid as a bi-product. Mitochondrial activity (not shown) now provides only about one - third of the ATP consumed.

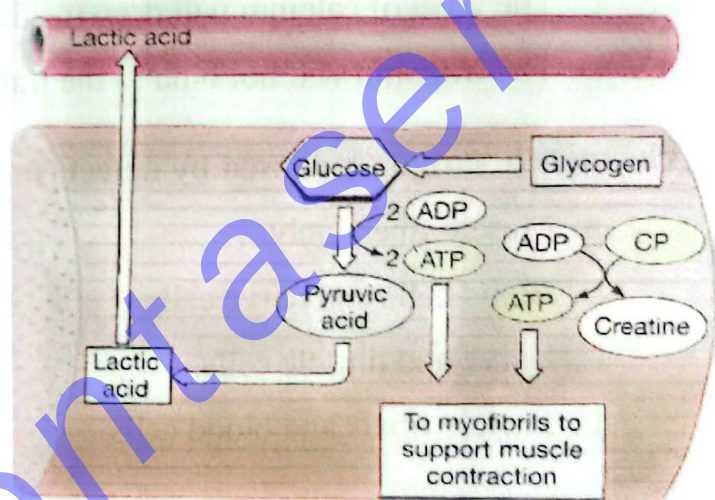


FIGURE 1.a, b and c. Muscle Metabolism. (a) A resting muscle breaks down fatty acids by aerobic metabolism to make ATP. Surplus ATP is used to build reserves of creatine phosphate (CP) and glycogen. (b) At moderate activity levels, mitochondria can meet ATP demands through the aerobic metabolism of fatty acids and glucose. (c) At peak activity levels, mitochondria cannot get enough oxygen to meet ATP demands. Most of the ATP is provided by glycolysis, leading to the production of lactic acid.

1. The muscle is said to be fatigued when it.....

- A.** stops being active.
- B.** contracts at a slower rate than normal.
- C.** contracts at the level of muscle fiber.
- D.** performs at a lower or a higher rate than normal.

2. Which of the following factors does not trigger/cause muscle fatigue?

- A. Damage of the muscle fibre membrane.
- B. Complete consumption of energy reserve in the muscle fiber.
- C. Absence of receptors of the neurotransmitter acetylcholine.
- D. Accumulation of metabolic waste of acidic fermentation.

3. The drop of the pH inside the muscle fiber will lead to muscle fatigue because.....

- A. The respiratory enzymes will stop being active.
- B. The respiratory enzymes will be less active.
- C. The level of calcium will drop inside the muscle fiber.
- D. The troponin will not bind to the transverse links of myosin.

4. The muscle fatigue is caused by defects in the.....

- A. Muscle fibers only.
- B. Blood cells and nerve cells.
- C. Nerve and muscle cells.
- D. Muscle fibers and blood cells.

5. The person who experiences muscle fatigue loses the desire to continue the activity because of troubles in.....

- A. Nerve cells and blood plasma.
- B. Muscle and brain cells.
- C. Blood plasma and blood cells.
- D. Blood cells and muscle fibers.

6. What is the similarity between muscle fatigue of a marathon runner and that of a sprinter?

- A. The low level of muscle performance.
- B. The type of energy reserve consumed.
- C. The type of muscle fiber respiration.
- D. The time the fatigue takes to develop.

7. Referring to the passage and to the figure (1, a., b., and c.), which level of muscle activity is (are) the level(s) at which muscle fatigue may develop?

- A. The peak level only.
- B. The moderate level only.
- C. The moderate and the peak levels.
- D. The resting muscle, the moderate and the peak levels.

Passage (2) :

A protein whose molecules curl up into a 'ball' shape, such as myoglobin and haemoglobin, is known as a globular protein. In a living organism, proteins may be found in cells, in tissue fluid, or in fluids being transported, such as blood or in the phloem. All these environments contain water. Globular proteins usually curl up so that their non-polar, hydrophobic R groups point into the centre of the molecule away from their watery surroundings. Water molecules are excluded from the centre of the folded protein molecule. The polar, hydrophilic, R groups remain on the outside of the molecule. Globular proteins, therefore, are usually soluble, because water molecules cluster around their outward-pointing hydrophilic R groups (figure 1). Many globular proteins have roles in metabolic reactions. Enzymes, for example, are globular proteins.

A Haemoglobin, the oxygen-carrying pigment found in red blood cells, is a globular protein. It is made up of four polypeptide chains. Two of these make an identical pair, and are called alpha (α) chains. The other two make a different identical pair and are called Beta (β) chains. The haemoglobin molecule is nearly spherical (figure 2.c). The four polypeptide chains pack closely together, their hydrophobic R groups pointing in towards the centre of the molecule and their hydrophilic ones pointing outwards.

The interactions between the hydrophobic R groups inside the molecule are important in holding it in its correct three-dimensional shape. The outward-pointing hydrophilic R groups on the surface of the molecule are important in maintaining its solubility. In the disease sickle cell anaemia one amino acid, which occurs in a part of the amino acid chain of the β polypeptides on the surface of the curled-up molecule, is replaced with a different amino acid. The correct amino acid is glutamic acid which is polar. The substitute is valine which is non-polar. Having a non-polar R group on the outside of the molecule makes the haemoglobin much less soluble, and causes unpleasant and dangerous symptoms in any one whose haemoglobin is all of this 'faulty' type (figure 3).

Each polypeptide chain contains a haem group, shown in (figure 2.b). A group like this, which is an important, permanent, part of a protein molecule but is not made of amino acids, is called a prosthetic group. Each haem group contains an iron ion, Fe^{2+} . One oxygen molecule, O_2 , can bind with each iron ion. So a complete haemoglobin molecule, with four

haem groups, can carry four oxygen molecules (eight oxygen atoms) at a time. It is the haem group which is responsible for the colour of haemoglobin. This colour changes depending on whether or not the iron ions are combined with oxygen. If they are, the molecule is known as oxyhaemoglobin, and is bright red. If not, the colour is purplish. $\rightarrow \text{No } \text{O}_2$

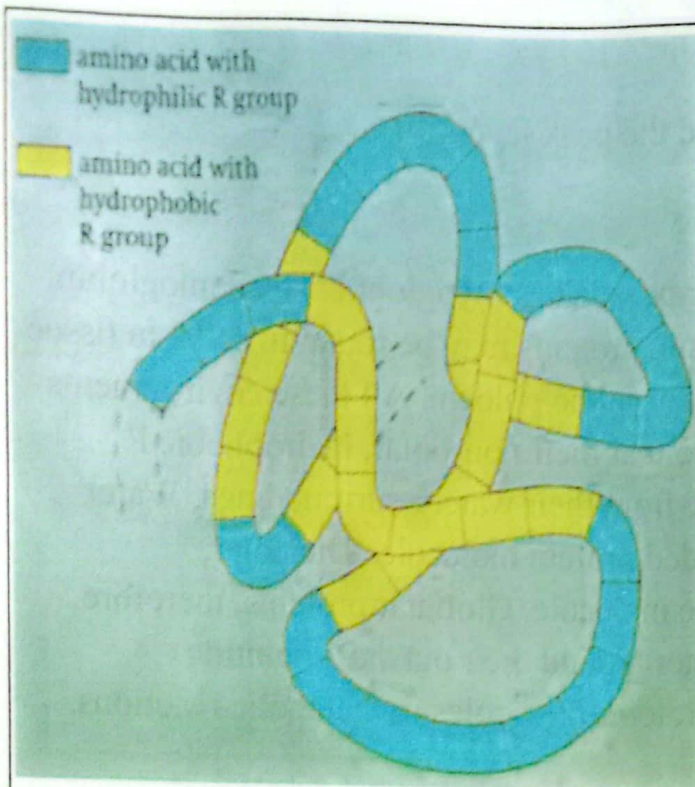


Figure 1. A schematic section through part of a Globular protein molecule. The polypeptide chain coils up with hydrophilic R groups outside and hydrophobic ones inside, which makes the molecule soluble.

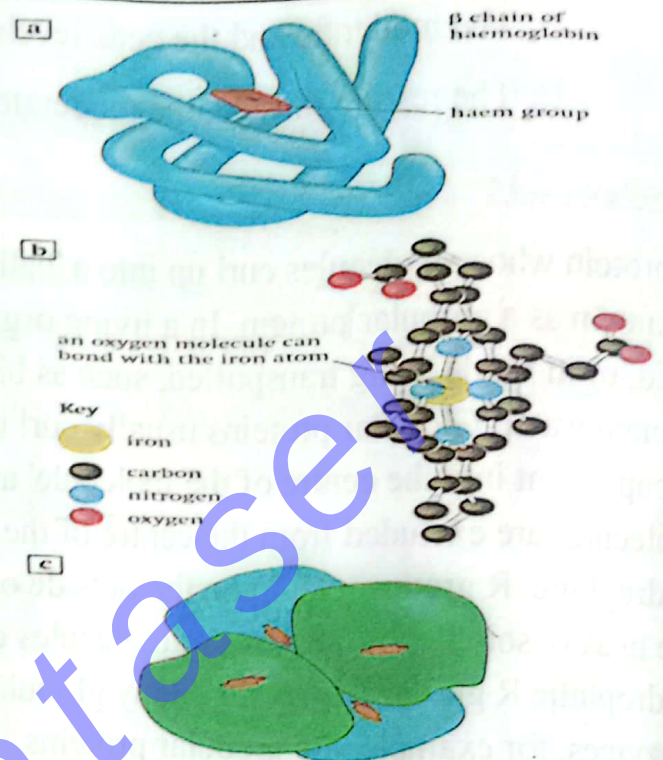


Figure 2. Haemoglobin. (a) Each haemoglobin molecule contains four polypeptide chains, one of which is shown here. Each polypeptide chain contains a haem group, shown in red. (b) The haem group contains an iron ion which can bond reversibly with an oxygen molecule. (c) The complete haemoglobin molecule is nearly spherical.

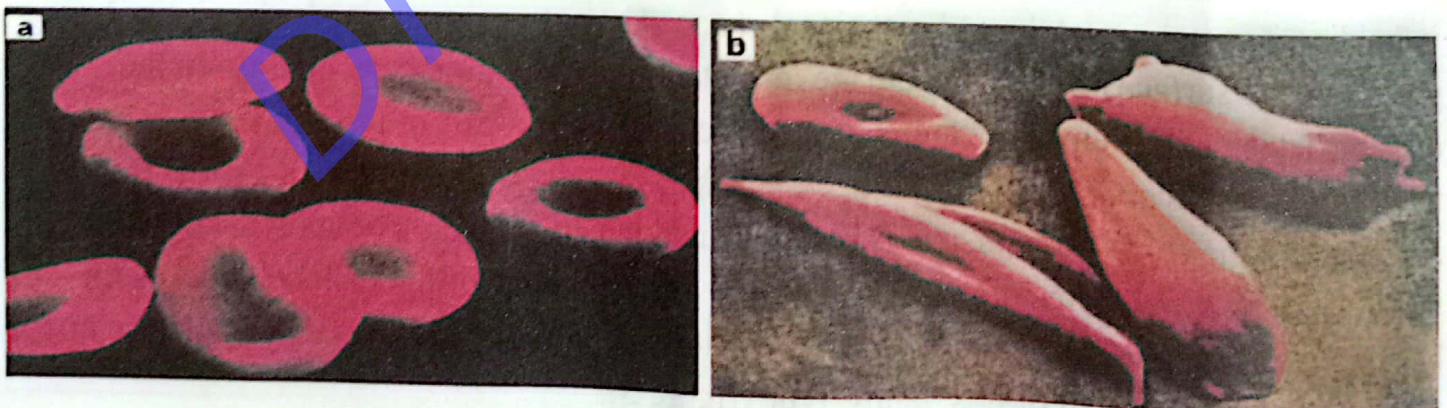


Figure 3. (a) Human red blood cells. Each cell contains about 250 million haemoglobin molecules ($\times 5500$). (b) A scanning electron micrograph of red blood cells from a person with sickle cell anaemia. You can see both normal and sickled cells.

8. All of the following are globular proteins EXCEPT

- A. Keratin.
- B. Haemoglobin.
- C. Enzymes.
- D. Myoglobin.

9. Globular proteins are described as “globular” molecules because

- A. Their hydrophobic R groups are directed inwards.
- B. Water molecules are removed the center of the molecule.
- C. They are soluble in water.
- D. They curl up into a spherical shape.

10. Which of the following best describes the structure of haemoglobin molecule?

- A. It consists of four identical polypeptide chains and four haem groups.
- B. It consists of two hydrophilic α chains and two hydrophobic β chains and four iron groups.
- C. It consists of two identical β chains, two identical α chains and 4 haem groups.
- D. It consists of four different polypeptide chains and four iron ions.

11. Which of the four polypeptide chains that constitute the haemoglobin molecule has/have hydrophilic and hydrophobic R groups in its/their chemical structure?

- A. The two alpha chains.
- B. The two beta chains.
- C. Alpha chains contain only hydrophilic R groups, while Beta chains contain only hydrophobic R groups.
- D. Each of the four chains contains hydrophilic and hydrophobic R groups in their Structure.

12. Which of the following factors make globular proteins soluble in water?

- A. The hydrophilic R groups are directed outside the molecule.
- B. The Hydrophobic R groups are oriented towards the molecule centre.
- C. The orientation of both hydrophilic and hydrophobic R groups in the molecule.
- D. The spherical shape of the molecule.

13. Which part of the faulty haemoglobin molecule in the disease of sickle cell anaemia has a flaw in its amino acid sequence?

- A. The surface of a single folded Beta chain.
- B. The surface of a single unfolded Beta chain.
- C. The surface of the two unfolded Beta chains.
- D. The surface of the two folded Beta chains.

Passage (3):

Certain factors are necessary for photosynthesis to occur, namely the presence of a suitable photosynthetic pigment, a supply of carbon dioxide, water and light energy. The main external factors affecting the rate of photosynthesis are light intensity, temperature and carbon dioxide concentration.

In the early 1900s F. F. Blackman investigated the effects of light intensity and temperature on the rate of photosynthesis. At constant temperature, the rate of photosynthesis varies with the light intensity, initially increasing as the light intensity increases (figure 1). However, at higher light intensities this relationship no longer holds and the rate of photosynthesis reaches a plateau.

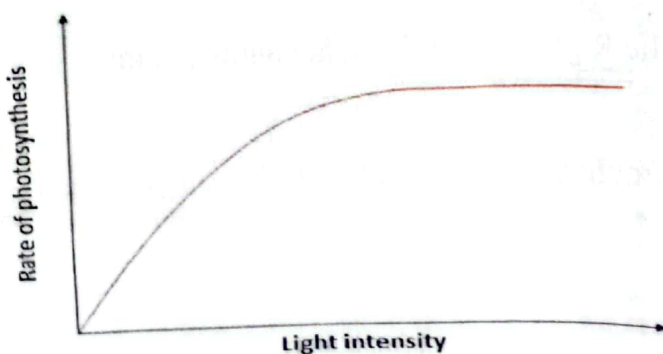


Figure 1 The rate of photosynthesis at different light intensities and constant temperature

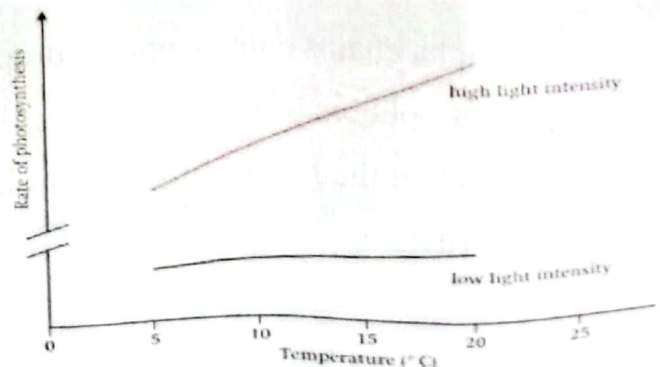


Figure 2 The rate of photosynthesis at different temperatures and constant light intensities.

The effect on the rate of photosynthesis of varying the temperature at constant light intensities can be seen in (figure 2). At high light intensities the rate of photosynthesis increases as the temperature is increased over a limited range. At low light intensities, increasing the temperature has little effect on the rate of photosynthesis.

These two experiments illustrate two important points. Firstly, from other research we know that photochemical reactions are not generally affected by temperature. However, these experiments clearly show that temperature affects the rate of photosynthesis, so there must be two sets of reactions in the full process of photosynthesis. These are a light-dependent photochemical stage and a light-independent, temperature dependent stage.

Secondly, Blackman's experiments illustrate the concept of "limiting factors". The rate of any process which depends on a series of reactions is limited by the slowest reaction in the series. In biochemistry, if a process is affected by more than one factor, the rate will be limited by the factor which is nearest its lowest value. Look again at figure 1. At low light intensities, the limiting factor governing the rate of photosynthesis is the light intensity; as the intensities increase so does the rate. But at high light intensities one or more other factors must be limiting, such as temperature or carbon dioxide supply.

At constant light intensities and temperature, the rate of photosynthesis initially increases with an increasing concentration of carbon dioxide, but again reaches a plateau at higher concentrations. A graph of the rate of photosynthesis at different concentrations of carbon dioxide has the same shape as that for different light intensities (figure 1). At low concentrations of carbon dioxide, the supply of carbon dioxide is the rate-limiting factor. At higher concentrations of carbon dioxide, other factors are rate-limiting, such as light intensity and temperature.

14. Which of the following could be an internal factor that affects the rate of photosynthesis?
- A. Light intensity.
 - B. The carbon dioxide concentration.
 - C. Pigment concentration.
 - D. Temperature.
15. Temperature will have a limited, but significant effect on the rate of photosynthesis only at
- A. High and changing light intensity.
 - B. High and low light intensities.
 - C. High light intensity and constant temperature.
 - D. High and constant light intensity.
16. The high light intensity has no effect on the rate of photosynthesis at constant temperature, and will have a reasonable effect on the rate of photosynthesis when
- A. temperature decreases.
 - B. temperature increases.
 - C. other limiting factors are constant.
 - D. light intensity is very high.
17. Photosynthesis is affected by temperature although of being a photochemical reaction because
- A. some of its reactions are light-dependent.
 - B. some of its reactions are light- independent.
 - C. its two sets of reactions are light-dependent.
 - D. its two sets of reactions are temperature-dependent.

18. The rate of photosynthesis will reach a plateau at high light intensity due to the effect of

- A. light intensity.
- B. temperature.
- C. CO₂ concentration or light intensity.
- D. CO₂ concentration or temperature.

19. CO₂ concentration will be the limiting factor of photosynthesis at

- A. high CO₂ concentration, high temperature and low light intensity.
- B. low CO₂ concentration, low light intensity and constant temperature.
- C. low CO₂ concentration, constant temperature and light intensity.
- D. constant CO₂ concentration, high temperature and low light intensity.

Passage (4) :

Antibiotics are drugs that are used to treat or cure infections. Effective antibiotics show selective toxicity, killing or disabling the pathogen but having no effect on host cells. There is a wide range of antibiotics to treat bacterial and fungal infections, but only very few for viral infections. Antibiotics are derived from living organisms, although other antimicrobial drugs, such as isoniazid used for the treatment of tuberculosis, are synthetic.

Antibiotics interfere with some aspect of growth or metabolism of the target organism such as: synthesis of bacterial walls, protein synthesis (transcription and translation), plasma membrane function and enzyme action. The main sites of action of antibiotics are shown in figure 1.

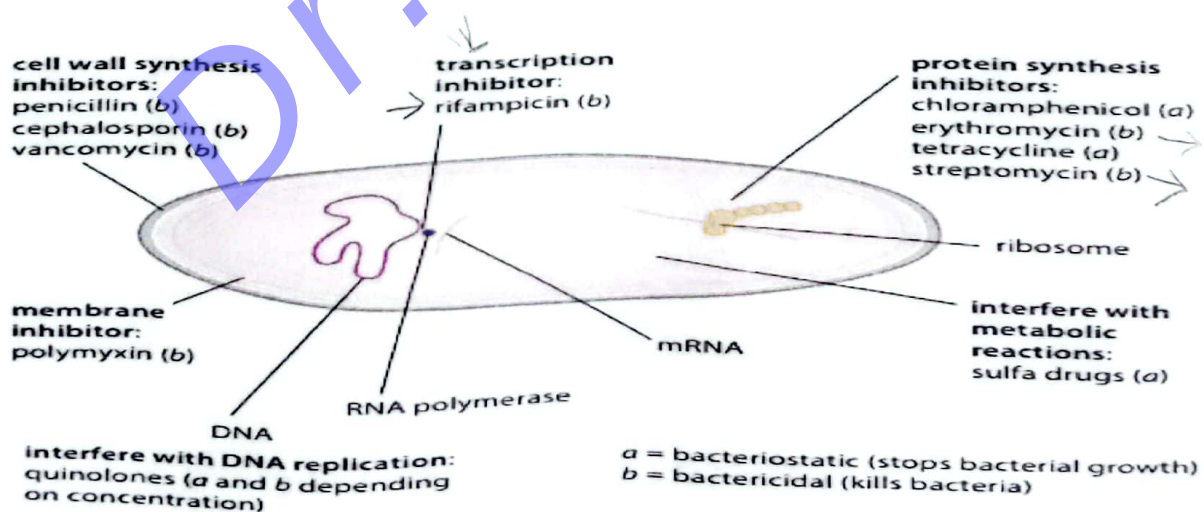


Figure (1): The site of action of antibiotics in bacteria

Different diseases are treated with different antibiotics. Some kinds of bacteria are completely resistant to particular antibiotics (for example- all strains of *M. tuberculosis* are resistant to penicillins) whilst other bacteria have certain strains that are resistant.

Broad spectrum antibiotics are effective against a wide range of bacteria, while narrow spectrum antibiotics are active only against a few.

One type of antibiotic, penicillins, function by preventing the synthesis of the cross-links between the peptidoglycan polymers in the ^{cell wall synth} cell walls of bacteria. This means that they are only active against bacteria and only while they are growing. Many types of bacteria have enzymes for destroying penicillins (penicillinases) and are therefore resistant to these antibiotics.

As a result of all these variables, antibiotics should be chosen carefully. Screening antibiotics against the strain of the bacterium or fungus isolated from sufferers ensures that the most effective antibiotic can be used in treatment. **Figure 2** shows the results of an antibiotic sensitivity test carried out on a pathogenic strain of the human gut bacterium *E. coli*. Bacteria are collected from faeces, food or water, and grown on an agar medium. Various antibiotics absorbed onto discs of filter paper and placed on the agar plate. The plate is incubated and the diameters of the inhibition zones where no bacteria are growing are measured. The diameters are compared with a table similar to **table 1** and the most effective antibiotics chosen to treat infected people.

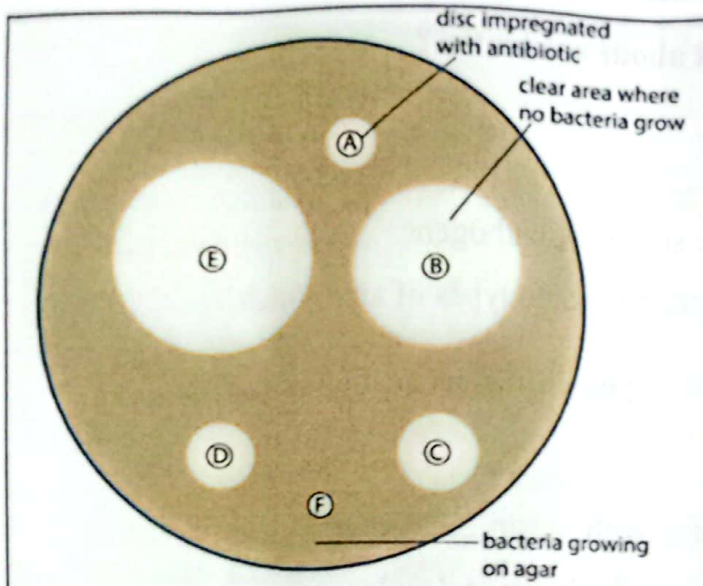


Figure 2: An antibiotic sensitivity test for a pathogenic strain of *Escherichia coli*

Antibiotic	Inhibition zone diameter (mm)	
	Resistant	Sensitive
A	≤ 11	≥ 14
B	≤ 12	≥ 18
C	≤ 9	≥ 14
D	≤ 11	≥ 22
E	≤ 12	≥ 15
F	≤ 14	≥ 19

Table 1 Inhibition zone diameters for the antibiotics of figure 13.11.

If the diameter of the inhibition zone for an antibiotic is equal to or less than the figure given in the first column, the bacteria are resistant to it. If the diameter is equal to or greater than the figure in the right hand column, the bacteria are sensitive and the antibiotic may be chosen for treatment.

20. Referring to the passage and figure 1, which of the following antibiotics interfere with the process of protein synthesis and bactericidal?

- A. Tetracycline only.
- B. Chloramphenicol only.
- C. Streptomycin only.
- D. Rifampicin and erythromycin.

21. Which of the following aspects of growth and metabolism are not affected by antibiotics?

- A. DNA replication.
- B. RNA synthesis.
- C. RNA translation.
- D. RNA polymerase action.

22. Which of the following is not correct about antibiotics?

- ☒ A. They are antimicrobial drugs.
- ☒ B. They are natural or synthetic.
- C. Each antibiotic can treat specific strains of pathogens.
- D. Some strains of bacteria are resistant to some types of antibiotics.

23. Some strains of bacteria are resistant to penicillins because they.....

- A. do not have a cell wall.
- B. form cell walls only during their growth.
- C. do not have cross-links between peptidoglycan molecules.
- D. have hydrolytic enzyme for penicillins.

24. Referring to the passage, figure 2 and table 1, which of the antibiotics would be the most effective to treat the patient with the pathogenic strain of *E. coli*?

- A. Antibiotic B.
- B. Antibiotic C.
- C. Antibiotic D.
- D. Antibiotic E.

25. Referring to the passage, figure 2 and table 1, the minimum diameter of the inhibition zone for any of the five antibiotics to be effective against the pathogenic strain of *E. coli* is

- A. less than or equal to 9 mm.
- B. less than or equal to 14 mm.
- C. more than or equal to 14 mm.
- ☒ D. more than or equal to 22mm.

END OF BIOLOGY SECTION

Passage (1):

Tsunamis are formidable natural phenomena with distinctive characteristics that set them apart from regular ocean waves. Triggered by underwater seismic activity such as earthquakes, volcanic eruptions, or underwater landslides (Fig. 1). Tsunamis demonstrate unique behaviors that make them challenging to detect and predict accurately. Understanding the anatomy and characteristics of tsunamis is crucial for developing effective warning systems, preparedness measures, and mitigation strategies to protect coastal communities. Most tsunamis are caused by large earthquakes. However, not all earthquakes cause tsunamis. Tsunamis are characterized by their long wavelengths, high speeds, and significant energy content. In the open ocean, their amplitudes (wave height) are relatively low, often less than one meter making detection challenging without specialized equipment (Fig. 2). However, as tsunamis approach shallow coastal areas, they undergo shoaling, resulting in a substantial increase in wave height and destructive potential. The non-periodic nature of tsunamis, multiple-wave patterns, and the occurrence of drawbacks and backwash further complicate prediction and response efforts.

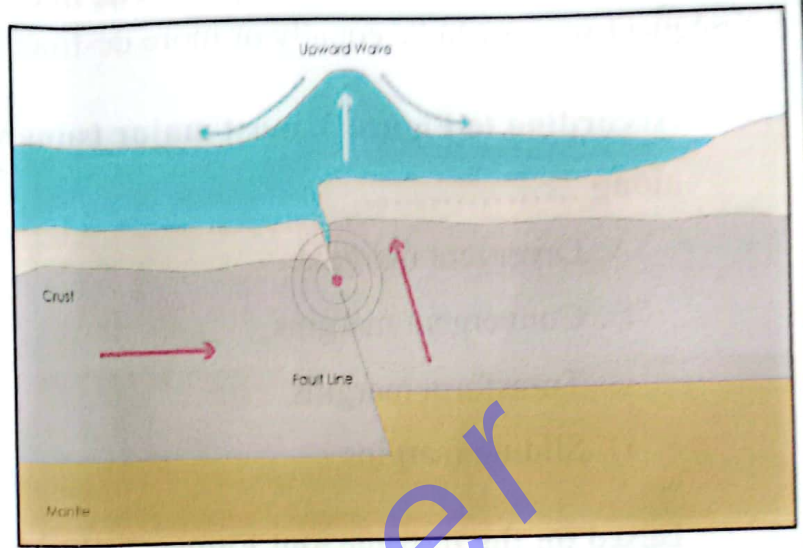


Fig. 1. Formation of Tsunami

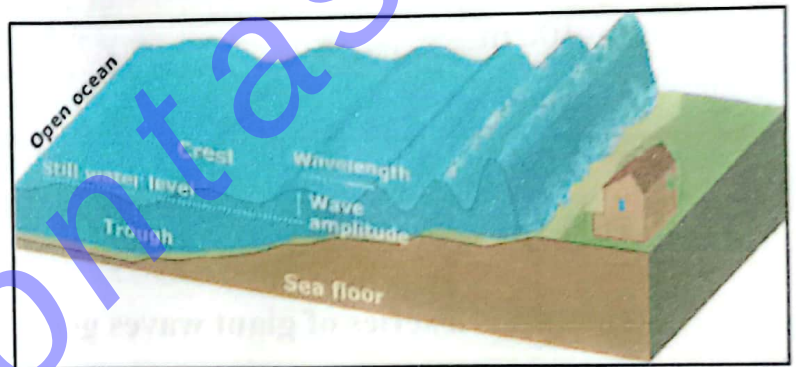


Fig. 2. Tsunami characteristics

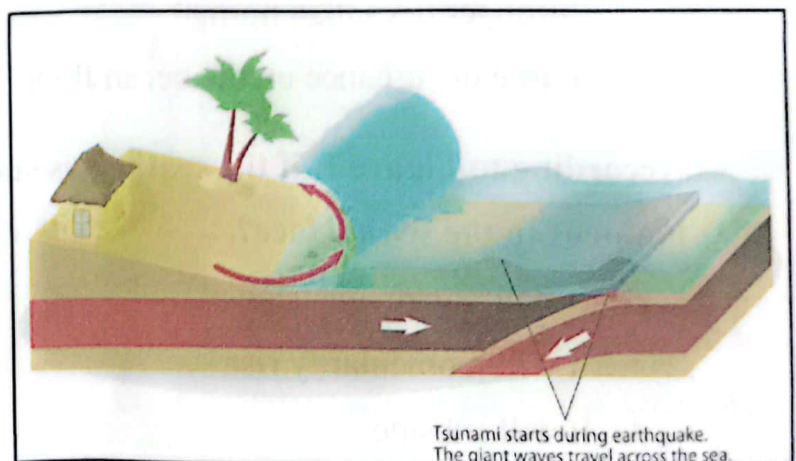


Fig. 3. Tsunami huge waves wash against the coast several times with great speed and force.

Tsunamis travel at incredibly high speeds, often exceeding 500 miles per hour (800 kilometers per hour) in deep ocean waters. This rapid speed allows them to traverse entire ocean basins. Tsunamis often consist of multiple waves separated by intervals of several minutes to over an hour (Fig. 3). The initial wave is not always the largest, and subsequent waves can be equally or more destructive.

- 26. According to Figure 3, most major tsunamis are generated by earthquakes along**
- A.** Divergent margins.
 - B.** Convergent margins.
 - C.** Transform margins.
 - D.** Sliding margins.
- 27. Based on the passage and Figure 2, the wave height of a tsunami is typically less than in the open ocean**
- A.** 100 m
 - B.** 10 m
 - C.** 1 m
 - D.** 0.1m
- 28. A tsunami is a series of giant waves generated by.....**
- A.** Storms.
 - B.** High winds.
 - C.** Stronger tides than normal.
 - D.** Large disturbance on the ocean floor.
- 29. According to Figure 1, if the seafloor is suddenly displaced upward, then what happens to the sea surface?**
- A.** It will remain unchanged.
 - B.** It will momentarily rise.
 - C.** It will subside.
 - D.** It will collapse.

30. Based on the passage and Figure 2, what do tsunamis look like in the open sea?
- A. Hardly noticeable waves.
 - B. Small cresting waves
 - C. Huge cresting waves
 - D. Huge non-cresting waves
31. Which of the following events does NOT cause a tsunami?
- A. Underwater or coastal earthquake.
 - B. Underwater landslides.
 - C. Underwater volcanic eruptions.
 - D. Underwater destructive flash floods of rivers into the ocean.
32. Which statement below is wrong?
- A. Tsunami waves are different from ordinary waves that you see at the beach.
 - B. Tsunami waves have a lot of energy and travel much further than ordinary waves.
 - C. Tsunami causes molten magma to rise from the Earth's mantle.
 - D. Not all earthquakes will generate a tsunami.

Passage (2) :

Wadi Al-Hitan, Whale Valley, in the Western Desert of Egypt, contains invaluable fossil remains of the earliest, and now extinct, a suborder of whales, Archaeoceti “ancient whales”, that lived from the Early Eocene to the late Oligocene (Fig.2). The fossils of Al-Hitan show the youngest archaeocetes, in the last stages of losing their hind limbs.

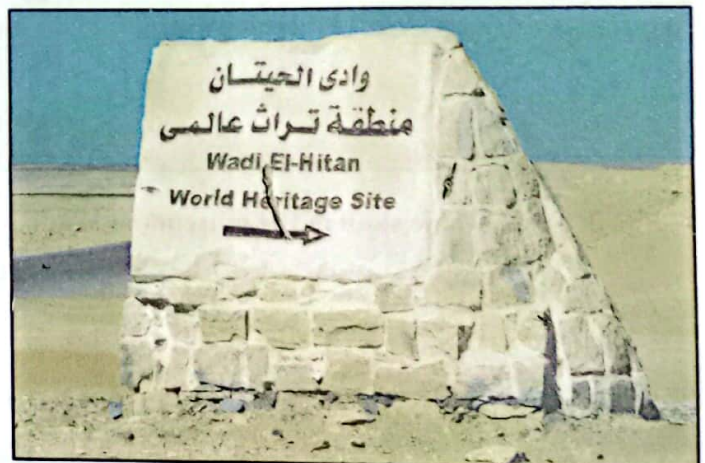


Fig. 1. Entrance sign to Wadi Al-Hitan, Faiyum, Egypt

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Fig. 1. Entrance sign to Wadi Al-Hitan, Faiyum, Egypt

Inscribed on UNESCO's World Heritage list under Natural Criterion in 2005, Wadi Al-Hitan (or Zeuglodon Valley) is about 12 kilometers west of the prominent hill of Garet Gehannam in the Wadi El Rayan Protected Area.

The fossils of Wadi Al-Hitan were discovered in 1902 by H. J. L. Beadnell of the Geological Survey of Egypt. Between 1983 and 2007, nine expeditions were led by Egyptian and American paleontologists. The expedition teams found and mapped about 400 whale and sea cow skeletons in the valley. During the 1989 expedition, the first fully aquatic whale specimens with legs and feet were discovered.

Eonothem/ Eon	Erathem/ Era	System/ Period	Series/ Epoch	Stage/ Age	millions of years ago
Phanerozoic	Cenozoic	Paleogene	Oligocene	Chattian	23.03
				Rupelian	27.82
			Eocene	Priabonian	33.9
				Bartonian	37.71
				Lutetian	41.2
				Ypresian	47.8
				Thanetian	56
				Selandian	59.2
			Paleocene	Danian	61.6
					66

Fig. 2. Subdivision of the Paleogene Period

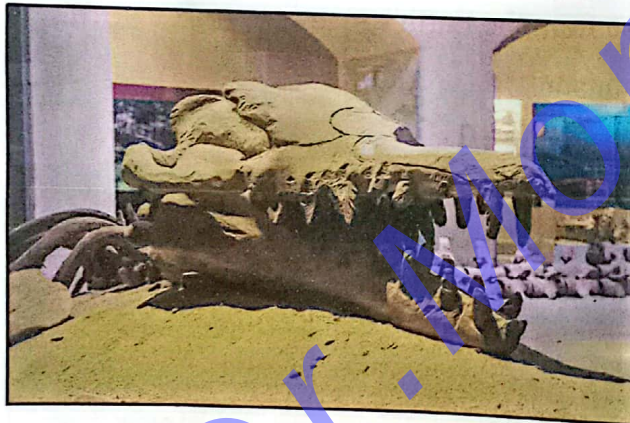


Fig. 3. Fossil whale skull in the museum at Wadi Al-Hitan



Fig. 4. *Basilosaurus isis* almost complete fossil skeleton in Wadi Al-Hitan

The fossilized whales at Wadi Al-Hitan help answer important questions about evolution. Today, whales are air-breathing mammals that live in the oceans. Evidence from Wadi El-Hitan and another important fossil site in Pakistan, show that whales evolved from four-legged, land-dwelling mammals. But what might have caused these land mammals to enter the sea? At the beginning of the Eocene Epoch, 55 million years ago, global temperatures increased more rapidly and to a greater degree than at any other time in geologic history.

These changes would have prompted some land mammals to seek new habitats. The shoreline may have become a more reliable place to find food. Over time, mammal species possibly evolved to rely on the abundance of fish and other foods in shoreline waters. Being able to move efficiently underwater would have been an advantage. Fossils of *Basilosaurus isis*, demonstrate the evolutionary changes that were underway with this species. *Basilosaurus* was the first whale to be described with functional hind limbs; remnants of their former existence on land (Figs.3,4).

33. According to Figure 2, Archaeoceti, the extinct suborder of whales that gave origin to modern-day whales, have been defined by their time span between:

- A. 37 to 23 million years ago.
- B. 50 to 23 million years ago.
- C. 59 to 33 million years ago.
- D. 66 to 41 million years ago.

34. Wadi Al-Hitan was included to the UNESCO World Heritage List at:

- A. 1902
- B. 1989
- C. 2005
- D. 2007

35. The Valley of the Whales or "Wadi Al-Hitan" was once named as:

- A. Fossil Valley.
- B. Zeuglodon Valley.
- C. El Rayan Valley.
- D. Garet Gehannam Valley.

36. At the beginning of the Eocene Epoch, land-dwelling vertebrates moved to the oceans due to the climate change:

- A.** As global temperatures rise, terrestrial mammals may seek new habitats and rely on shoreline waters for food sources.
- B.** As global temperatures dropped, some terrestrial mammals sought new habitats, potentially relying on shoreline waters for food.
- C.** As global temperatures rose, some terrestrial mammals sought new habitats, potentially relying on shoreline waters for oxygen.
- D.** As global temperatures dropped, some terrestrial mammals sought new habitats, potentially relying on shoreline waters for oxygen.

37. Wadi Al-Hitan's fossilized whales provide valuable insights into evolution, because:

- A.** It represents a more important fossil site than the whale fossil site discovered in Islamabad, northern Pakistan.
- B.** The fossilized whales in Wadi Al-Hitan mark a crucial transitional stage in whale evolution, from four-legged, land-dwelling mammals to entirely aquatic creatures.
- C.** It provides a historical illustration of climatic change in the late Eocene and how greenhouse gases affected life on Earth.
- D.** The fossilized whales in Wadi Al-Hitan highlight the link between Oligocene land-dwelling mammals and the extinction of dinosaurs.

38. *Basilosaurus isis* was an enormous aquatic predator, with a name meaning 'king lizard', it is currently classified as:

- A.** Reptile.
- B.** Fish.
- C.** Amphibian.
- D.** Mammal.

Passage (3) :

Man has used petroleum since Biblical times, yet the origin of this natural resource remained a mystery for much of man's history. In his 1546 text *De Natura eorum quae Effluunt ex Terra*, Georgius Agricola, a German physician, expanded on the Aristotelian concept of exhalations from deep within the Earth and proposed that bitumen (a petroleum-based hydrocarbon), like other minerals, condensed from sulfur. Andreas Libavius, another German physician, theorized in his 1597 text *Alchemia* that bitumen formed from the resins of ancient trees. These early discussions mark the beginnings of one of the longest-running scientific debates: whether petroleum is formed by abiogenic processes that occur deep within the Earth, or from sedimentary organic matter that was once living organisms.

The Inorganic or Abiotic origin of petroleum states that hydrogen and carbon came together under great temperature and pressure, far below the earth's surface, and formed oil and gas

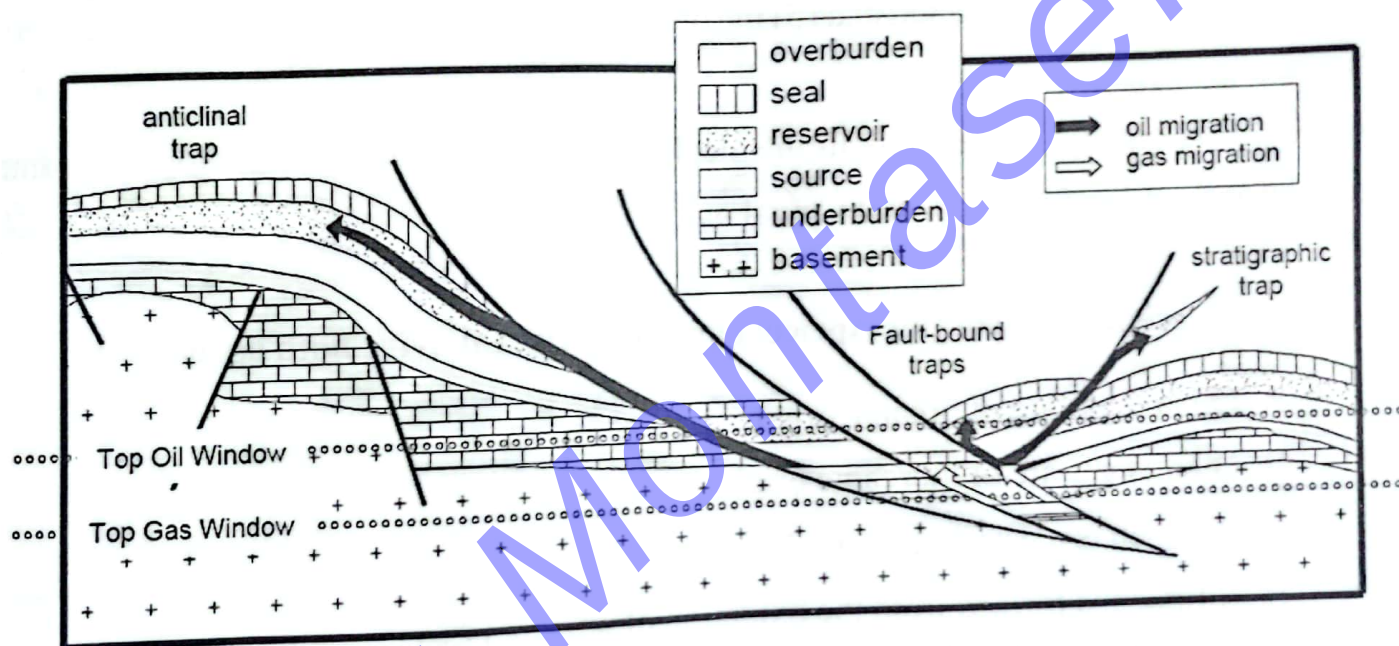


Fig. 1. Elements of a petroleum system and types of petroleum traps.

where chemical reactions have occurred. Some different theories describe the inorganic origin of petroleum which include: metal carbide theory, volcanic theory, earthquake theory, and serpentinization theory. The metal carbide theory was developed by a Russian chemist and states that the deposition of petroleum is controlled by tectonic activities that occurred during the life of sedimentary rock. Metal carbides deep in Earth react with water at high pressure and temperature to form acetylene which condenses to heavier hydrocarbons. On the other hand, the **organic origin of petroleum** is the most widely accepted. The oil and gas are formed from the remains of prehistoric plants and animals.

These remains were settled into seas accumulated at the ocean floor and buried under several kilometers of sediments. Over a few million years, the layers of the organic material were compressed under the weight of the sediments above them. The increase in pressure and temperature with the absence of oxygen changed the mud, sand, silt, or sediments into rock and organic matter into **Kerogen**. After further burial and heating, the kerogen transformed via cracking into petroleum and natural gas. The overwhelming evidences for the organic origin of petroleum are: (1) the presence of brine (sea water) with petroleum, (2) petroleum is found only in association with sedimentary rocks, there is no petroleum associated with igneous or metamorphic rocks, (3) polarized light passing through all petroleum resources undergoes a rotation that is similar to all organic oils, (4) molecules in hydrocarbons are thought to be similar to that of the organic matter, and (5) the organic carbon found in plants is depleted into C^{13} due to photosynthesis process, in dead organic matter, it is further depleted due to radioactive decaying, the same depletion was found in petroleum and natural gas.

39. German scientists Georgius Agricola and Andreas Libavius both agree that:

- A. Oil and gas are of organic origin.
- B. Oil and gas are of inorganic origin.
- C. Bitumen is a petroleum-based hydrocarbon.
- D. Bitumen is formed from the oxidation of ancient trees.

40. According to Figure 1, the structural trap formed by the folding of rock strata into an arch-like shape is:

- A. Anticlinal trap.
- B. Stratigraphic trap.
- C. Fault-bound trap.
- D. Anticlinal and fault-bound traps.

41. In the given figure, the gas window is located at a depth of 3 to 6 km and has temperatures ranging from 100 to 200+ degrees Celsius, therefore:

- A. The oil window can be found in depths higher than 6 kilometers temperatures ranging from 200 to 250 degrees Celsius.
- B. The oil window can be found in depths higher than 6 kilometers and temperatures ranging from 80 200 to 160 degrees Celsius.
- C. The oil window can be found in depths less than 3 kilometers and temperatures ranging from 200 to 250 degrees Celsius.
- D. The oil window can be found in depths less than 3 kilometers and temperatures ranging from 80 to 160 degrees Celsius.

42. The term "Abiotic" in biology refers to:

- A. Living components or attributes of a system that usually bear physical and chemical traits but no biotic traits.
- B. Non-living components or attributes of a system that usually bear physical and chemical traits but no biotic traits.
- C. Non-living components or attributes of a system that usually bear physical and chemical traits but biotic traits.
- D. Living components or attributes of a system that usually bear physical and chemical traits but biotic traits.

43. In the metal carbide theory.

- A. At low temperatures, metallic carbides in the Earth react with water to produce acetylene (C_2H_2), which then condenses to generate light hydrocarbons.
- B. At high temperatures, metallic carbides in the Earth react with water to produce acetylene (C_2H_2), which then condenses to generate light hydrocarbons.
- C. At high temperatures, metallic carbides in the Earth react with water to produce acetylene (C_2H_2), which then condenses to generate heavier hydrocarbons.
- D. At low temperatures, acetylene (C_2H_2) in the Earth reacts with water to produce metallic carbides, which then condense to generate heavier hydrocarbons.

44. The evidence for the biological genesis of petroleum includes all the following EXCEPT:

- A. Petroleum is only found in sedimentary rocks, oil and natural gas are depleted in C^{13} , and brine co-occurs with petroleum.
- B. Petroleum can be found in granite, basalt, and schist rocks, particularly those generated under high pressure and temperature.
- C. The polarized light passing through petroleum resources and hydrocarbon molecules is believed to be like that of organic matter.
- D. The discovery of fossil spores and pollen grains in many crude oils all over the world

Passage (4) :

The **Yangtze River** is the longest in China and is the world's 3rd longest (only the **Nile** and **Amazon** are longer). It flows for ~6300 km from its headwaters on the **Tibetan Plateau** to its delta at Shanghai, where it discharges to the **East China Sea**. The **Yangtze** watershed encompasses approximately $\frac{1}{5}$ of China's land area. However, the **Yangtze** is also notorious for its frequent and devastating floods. To protect over 15 million people in Shanghai and the lower Yangtze floodplains, and control flooding of almost 15,000 square km of land, construction of the **Three Gorges Dam** began in 1994 (Fig.1). The dam was designed to withstand an earthquake of no more than magnitude 6.0.



Fig. 1. The Three Gorges Dam on the Yangtze River, China

The long, narrow Three Gorges Reservoir extends ~600 km upstream and has a capacity of almost 40 billion m^3 of water (equivalent to about 32 million acre-feet). At the time of construction, the dam was the largest hydroelectric power plant on Earth, with a generating capacity of over 20,000 megawatts - (more than 20 times that of Hoover Dam, equivalent to 18 nuclear power plants, and enough to supply almost 10% of China's power demand. According to the Chinese government, if

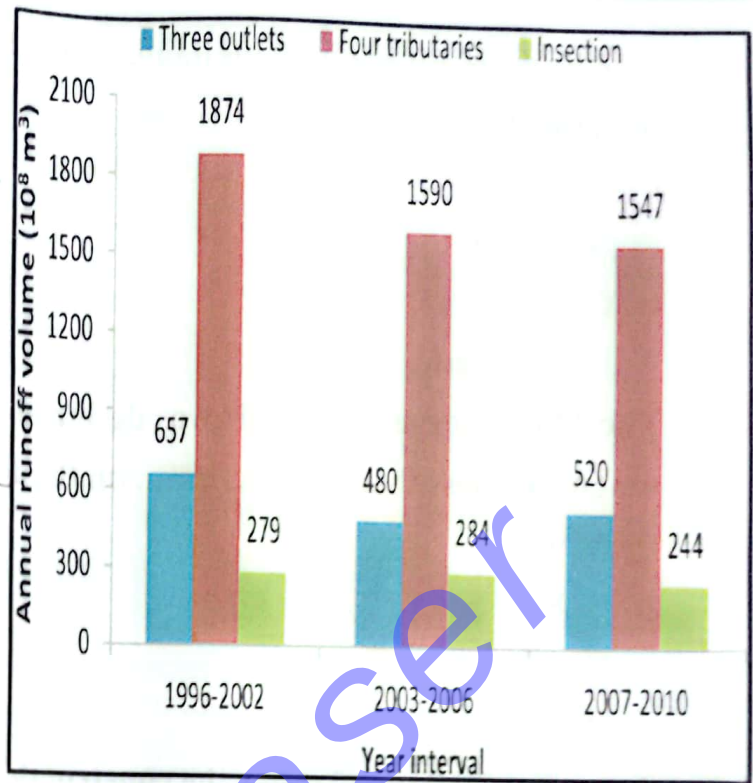


Fig. 2. Annual runoff volume (10^8 m^3) of Dongting Lake before and after the operation of the Three Gorges Dam.

this amount of electricity were generated using coal-fired power plants instead, 100 million tons of additional carbon dioxide would be released into the atmosphere. Despite the obvious benefits of the dam for the economy and generation of renewable energy, the Three Gorges Dam has been mired in controversy since its inception. The chief environmental issues center on impacts to river ecology and already threatened species increased chances for waterborne diseases, and water quality degradation associated with the slowed flow of the river in the backwaters of the dam, in tributaries, and downstream regions (Fig. 2).

In 2005, NASA scientists calculated that the shift of water mass stored by the dams would increase the total length of the Earth's Day by 0.06 microseconds. Scientifically, day and night are due to the Earth rotating on its axis, not its orbiting around the sun. The term 'one day' is determined by the time the Earth takes to rotate once on its axis and includes both daytime and nighttime. Also, a study published in 2022 in the journal Open Geosciences suggests that the change in reservoir water level, along with the infiltrated water affects the gravity field in western Sichuan, which in turn affects the seismicity in that area, and reactivates the existing faults, and the risk of induced earthquakes significantly increases.

45. The Yangtze River or Changjiang, with a length of 3,915 miles (6,300 km), is the longest river in:
- A. Africa.
 - B. Europe.
 - C. Asia.
 - D. Euramerica.
46. The Three Gorges Reservoir was designed to withstand earthquakes of magnitude less than on the Richter scale.
- A. 9.0
 - B. 8.0
 - C. 7.0
 - D. 6.0
47. According to figure 2, after the construction of the Three Gorges Dam in 2003, water discharged into the Dongting Lake through the three outlets (between 2003-2010) is:
- A. Increased then decreased.
 - B. Decreased then increased.
 - C. Remains unchanged.
 - D. Decreased gradually.
48. All the following are considered as positive environmental impacts of the Three Gorges Reservoir in China, EXCEPT:
- A. Generating 20,000 megawatts with coal-fired power plants instead of the Three Gorges Dam would result in the release of an additional 100 million tons of CO₂ into the environment.
 - B. Supply water for the largest hydroelectric plant in the world and to help control the devastating floods that plague the lowlands downstream from the dam.
 - C. The construction of the Three Gorges Dam has caused significant and irreversible impacts to critically endangered species and critical natural habitats.
 - D. The electricity provided by the Three Gorges Reservoir may reduce the use of nuclear power reactors and mitigate their risks.

49. The construction of Three Gorges Reservoir results in a 0.06-microsecond increase in the duration of Earth's Day, because:
- A. The Earth becomes somewhat rounder in the middle and flat toward the poles.
 - B. The Three Gorges Reservoir influences the Earth's tilt and rotation speed.
 - C. The change in reservoir water level alters the gravity field in western Sichuan, which in turn affects seismic activity in the region.
 - D. The Three Gorges Dam has decreased daylight hours by 0.06 milliseconds.
50. A 2010 study by the China Earthquake Administration found that Three Gorges Dam had triggered about 3,400 earthquakes from mid-2003 to the end of 2009, because:
- A. The rise of reservoir water, and the infiltration of reservoir water along the fault zone, gradually affected the stress state of the fault.
 - B. The rise of reservoir water, and the infiltration of reservoir water along the fold zone, gradually affected the stress state of the fold.
 - C. The rise of reservoir water, and the recharge of reservoir water along the fold zone, which gradually did not affected the strain state of the fault.
 - D. The drop of reservoir water, and the infiltration of reservoir water along the fault zone, which gradually did not affect the stress state of the fault.

END OF TEST



٢٠١٦/أول

جمهورية مصر العربية
وزارة التربية والتعليم والتعليم الفني
امتحان شهادة إتمام الدراسة الثانوية العامة
لمدارس المتفوقين في العلوم والتكنولوجيا (STEM)
(الدور الأول ٢٠٢٥)

اختبار الاستعداد للقبول بالجامعات
علوم ٢ (أحياء + علوم الأرض)

زمن الإجابة : ساعة ونصف

تنبيه مهم : يسلم الطالب ورقة (Bubble Sheet) مع كراسة الأسئلة للإجابة بها .

اسم الطالب (رباعياً) :

المدرسة : الإدارة :

رقم الجلوس : المحافظة :

STEM 2025

غير مطروح للطلاب بالكنية فى هذه الصفحة

STEM 2025

غير مطروح للطلاب بالكنية فى هذه الصفحة

STEM 2025

غير مطروح للطلاب بالكنية فى هذه الصفحة

Science, Technology, Engineering and Mathematics Schools
(STEM) Schools
Final Exam 2025

Subject : URT Test – Science (II)

Grade: 12

Time : 90 minutes

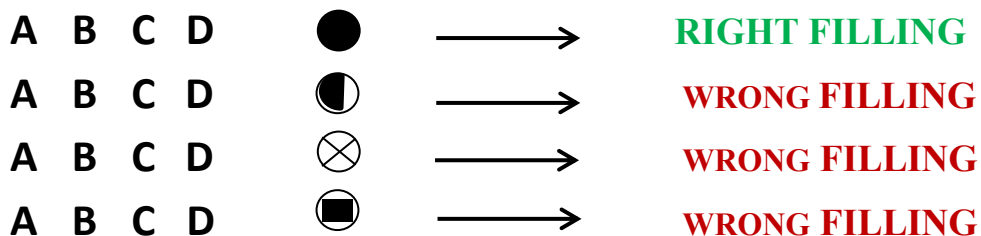
Instructions

- Follow the instructions on your question paper.
- Make sure you put your answer filled with the correct question number.
- **Use a soft pencil and do not use a pen.**
- Rub out any answer you wish to change.

All the questions in this test are Multiple-choice. The questions are included in one booklet. This booklet contains Science II (Earth Science and Biology) There are 25 questions in Earth Science and 25 questions in Biology. in the test. It measures skills and abilities highly related to the completed course works in Grades 1, 2 and 3 STEM schools.

The questions in the test are numbered, and the suggested answers for each question are lettered **A, B, C** and **D**. On the answer sheet, the rows of ovals are numbered to match the questions, and the ovals in each row are lettered to correspond to the suggested answers.

For each question, first decide which answer is best. Next, locate your answer on the answer sheet according to the row of ovals numbered the same as the question. Then, locate the oval in that row lettered the same as your answer. Finally, fill in the oval completely.



Mark only one answer to each question. If you change your mind about an answer, erase your first choice thoroughly before marking your new answer. For each question, make certain that you mark in the row of ovals with the same number as the question.

Only responses marked on your answer document will be scored. Your score on each test will be based only on the number of questions you answer correctly during the time allowed for that test. You will NOT be penalized for guessing. ***IT IS TO YOUR ADVANTAGE TO ANSWER EVERY QUESTION EVEN IF YOU MUST GUESS.***

If you finish a test before time is called for that test, you should use the time remaining to reconsider questions you are uncertain about in that test.

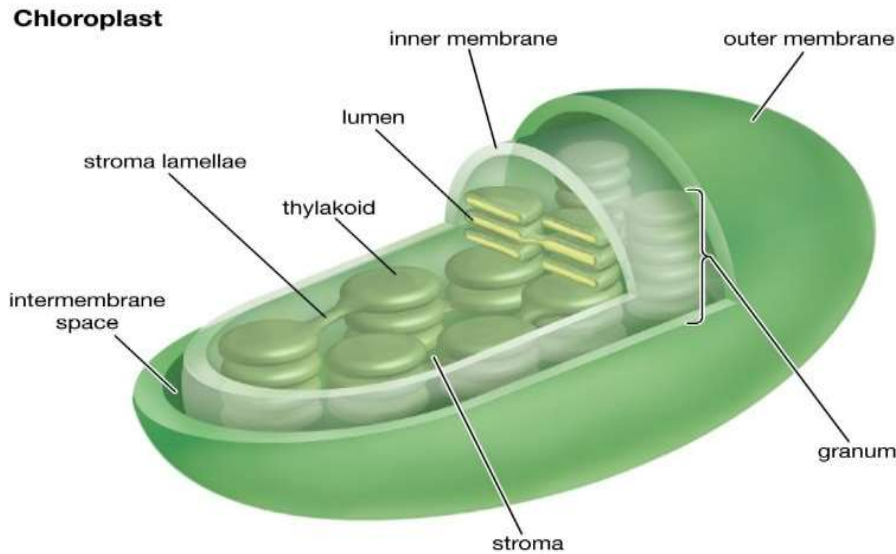
Lay your pencil down immediately when time is called at the end of the test. You may NOT for any reason fill in or alter ovals for the test after time is called for that test. Doing so, you will be disqualified from the examination. Do not fold or tear the pages of your test booklet.

DO NOT OPEN THIS BOOKLET UNTIL TOLD TO DO SO.

تنبيه مهم: عدد صفحات كراسة الأسئلة : (الغلاف الخارجى + التعليمات صفحة واحدة + الأسئلة (٢٤) صفحة + (٤) صفحات مسودة)
وفقد أية ورقة من الكراسة يعتبر مسئولية الطالب.

Biology Section – Questions (1 – 25)

Passage (I) :



Photosynthesis is the process by which plants convert light energy into chemical energy, stored in the form of glucose. This process occurs in the chloroplasts, which contain chlorophyll pigment. Chloroplasts have a double membrane and contain thylakoids, where the light-dependent reactions occur, and the stroma, where the Calvin cycle takes place. Mutations in the genes responsible for chloroplast function can affect photosynthesis.

In a study, three types of *Arabidopsis thaliana* plants were used:

1. **Normal plants** with fully functional chloroplasts.
2. **Strain A:** Mutant plants with a defect in the thylakoid membrane, preventing the formation of the proton gradient needed for ATP synthesis.
3. **Strain B:** Mutant plants with a defect in the enzyme RuBisCO, which is essential for carbon fixation in the Calvin cycle.

Experiment 1

The three types of plants were grown under identical conditions with sufficient light, water, and carbon dioxide. After 30 days, their growth was measured by dry biomass. The results showed that normal plants grew significantly more than Strain A and Strain B, which showed stunted growth.

Experiment 2

Leaf discs from each plant type were placed in a solution containing a pH indicator. When photosynthesis occurs, the uptake of CO₂ causes the solution to become less acidic (pH increases). The change in pH was measured over 30 minutes. The results are shown in the table below:

Plant Type	pH Change (Δ pH)
Normal	+1.2
Strain A	+0.3
Strain B	+0.1

Questions numbers (1) to (5) are related to passage I:

- Which of the following best describes the role of the thylakoid membrane in photosynthesis?
 - It is the site of the Calvin cycle.
 - It generates ATP and NADPH using light energy.
 - It fixes carbon dioxide into glucose.
 - It stores glucose for later use.
- In Experiment 2, why did Strain A show a smaller pH change compared to normal plants?
 - Strain A cannot absorb light due to defective chlorophyll.
 - Strain A cannot produce ATP, reducing CO₂ uptake.
 - Strain A has a defective Calvin cycle, preventing glucose production.
 - Strain A cannot absorb water, limiting photosynthesis.

- 3. Which of the following statements is supported by the results of Experiment 1?**
- A. Both the thylakoid membrane and RuBisCO are essential for plant growth.
 - B. Only the thylakoid membrane is essential for plant growth.
 - C. Only RuBisCO is essential for plant growth.
 - D. Neither the thylakoid membrane nor RuBisCO is essential for plant growth.
- 4. Suppose a third mutant strain (Strain C) is discovered that lacks both a functional thylakoid membrane and RuBisCO. What would be the expected results if Strain C was subjected to the same experiments?**
- A. In Experiment 1, Strain C would grow normally; in Experiment 2, it would show a pH change of +1.2.
 - B. In Experiment 1, Strain C would show stunted growth; in Experiment 2, it would show no pH change.
 - C. In Experiment 1, Strain C would grow normally; in Experiment 2, it would show no pH change.
 - D. In Experiment 1, Strain C would show stunted growth; in Experiment 2, it would show a pH change of +1.2.
- 5. Which of the following best explains why Strain B showed the smallest pH change in Experiment 2?**
- A. Strain B cannot absorb light, preventing the light-dependent reactions.
 - B. Strain B cannot fix carbon dioxide, reducing the uptake of CO₂.
 - C. Strain B cannot produce ATP, limiting the Calvin cycle.
 - D. Strain B cannot absorb water, halting photosynthesis entirely.

Passage (II) :

For many years, scientists debated the number of genes in the human genome. Early estimates, based on the complexity of human biology, suggested there could be as many as 100,000 protein-coding genes. This assumption was largely influenced by the fact that simpler organisms, such as bacteria, had relatively fewer genes, leading researchers to believe that the human genome must be vastly larger.

However, with the completion of the Human Genome Project (HGP) in 2003, these estimates were dramatically revised. The project revealed that the human genome contains far fewer genes than previously thought—around 20,000 to 25,000 protein-coding genes. This was surprising because it meant that humans had only slightly more genes than some much simpler organisms, such as the roundworm *Caenorhabditis elegans*, which has about 20,000 genes. This raised fundamental questions about what truly determines biological complexity.

One explanation for this apparent discrepancy is the role of non-coding DNA and gene regulation. While protein-coding genes make up only a small fraction of the genome, non-coding regions play crucial roles in regulating gene expression, alternative splicing, and epigenetic modifications. These mechanisms allow a relatively small number of genes to produce a vast diversity of proteins and functions.

Furthermore, research has shown that humans rely heavily on post-transcriptional regulation, RNA editing, and interactions between proteins, which enhance functional complexity without requiring a larger number of genes. Some scientists argue that the focus should shift away from simply counting genes and instead toward understanding how they are controlled and interact within the broader genomic landscape.

Ultimately, the debate over gene numbers highlights the evolving nature of genomics and reinforces the idea that biological complexity is driven by more than just the raw number of genes.

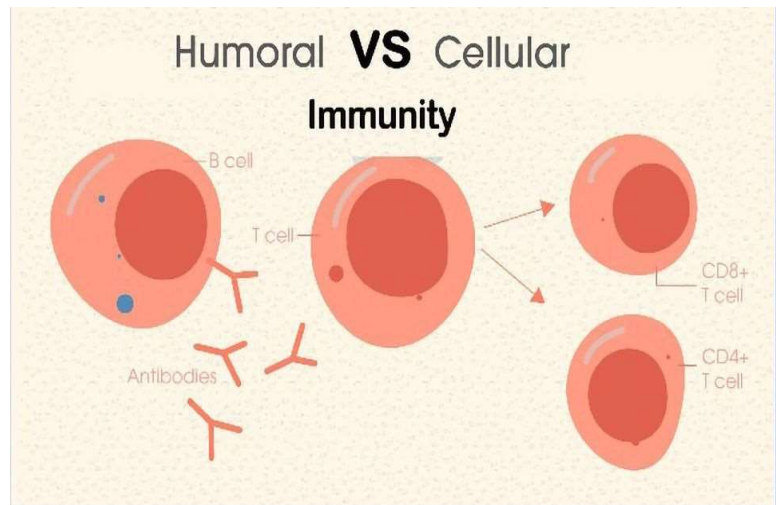
Questions numbers (6) to (11) are related to passage II:

- 6. The early estimates of the number of genes in the human genome were based on the fact that.....**
- A.** Bacterial genes are simpler in their structure than the human genes.
 - B.** The number of genes in a genome is influenced by the species complexity.
 - C.** Human genome is vastly larger than bacterial genome.
 - D.** Bacterial genome is prokaryotic, but human genome is eukaryotic.

7. Which of the following is true about the human genome compared with the roundworm *Caenorhabditis elegans*?
- A. Both genomes have equal number of protein-coding genes.
 - B. Both genomes have equal number of non- coding regions.
 - C. Human genome produces about 5000 more proteins than *C. elegans* genome.
 - D. The number of genes in both genomes reflect their biological complexity.
8. All of the following are possible mechanisms for the production of a huge diversity of proteins using a relatively small number of genes EXCEPT:
- A. Alternative DNA splicing.
 - B. Regulating gene expression.
 - C. Epigenetic modifications.
 - D. RNA editing.
9. Which of the following make up most of the human genome?
- A. Protein coding genes.
 - B. Non-coding DNA.
 - C. 20,000 – 25,000 genes.
 - D. Small number of genes.
10. Which of the following is NOT a post-transcriptional gene regulation?
- A. Alternative splicing.
 - B. RNA editing.
 - C. Protein interactions.
 - D. RNA synthesis.
11. Which of the following could be a possible indicator for biological complexity?
- A. The amount of non-coding DNA in a genome.
 - B. The fewer number of protein-coding genes in a genome.
 - C. The more variety of gene regulation mechanisms.
 - D. The timing of gene expression; pre or post transcriptional.

Passage (III) :

In the early 20th century, scientists were still uncovering the mechanisms of how the immune system protects organisms from infectious diseases. A major debate emerged over whether immunity was primarily mediated by cellular components, such as white blood cells, or by soluble factors in the blood, such as antibodies. Two competing hypotheses emerged:



Cellular Immunity Hypothesis: The immune response is primarily driven by specialized immune cells, particularly phagocytes. These cells actively engulf and digest pathogens, providing direct defense against infections. Scientists supporting this hypothesis pointed to experiments showing that certain white blood cells increased in number and activity in response to infections. Additionally, they noted that transferring immune cells from an exposed organism to a naive one could sometimes confer protection.

Humoral Immunity Hypothesis: The immune response is primarily mediated by soluble molecules, specifically antibodies found in the blood and other bodily fluids. Supporters of this hypothesis observed that transferring blood serum from an immune organism to a non-immune one could sometimes provide immunity without transferring any cells. They argued that antibodies, which recognize and neutralize pathogens, were the key mediators of immune protection. This hypothesis gained further support from studies showing that individuals with immune deficiencies often had defective antibody production.

Question numbers 12 to 18 are related to Passage III.

12. According to the Cellular Immunity Hypothesis, which of the following observations provides the strongest evidence that immunity is mediated by cells rather than antibodies?

- A. White blood cells increase in response to infection.
- B. Antibodies neutralize pathogens in laboratory tests.
- C. Serum from an infected individual contains immune factors.
- D. White blood cells remain in the bloodstream after infection.

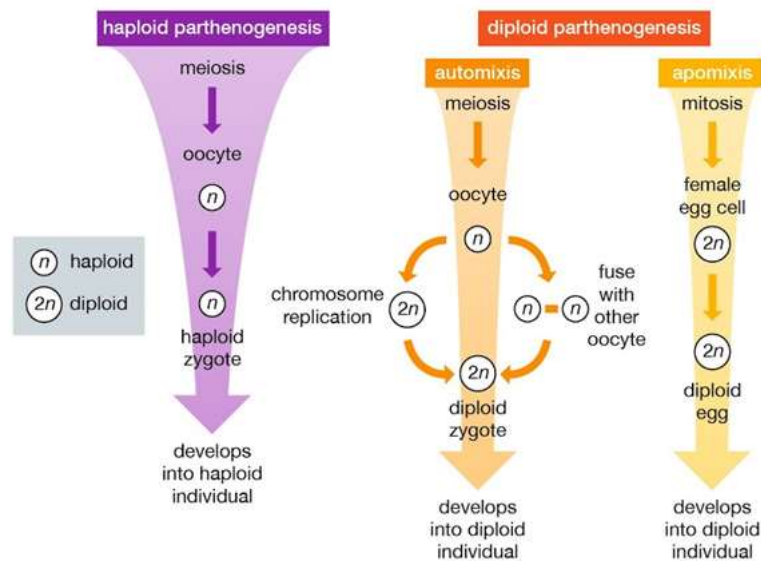
- 13. Scientists supporting the Humoral Immunity Hypothesis would most likely cite which of the following as evidence in their favor?**
- A. Antibodies engulf and digest bacteria.
 - B. Serum from immune individuals can transfer immunity.
 - C. White blood cells migrate to sites of infection.
 - D. The number of immune cells in the blood increases after vaccination.
- 14. Which of the following findings would most likely weaken the Humoral Immunity Hypothesis?**
- A. Antibodies are detected in the blood after infection.
 - B. White blood cells can be trained to recognize pathogens.
 - C. Some infections persist despite the presence of antibodies.
 - D. Vaccination increases antibody production in the blood.
- 15. A scientist discovers a new pathogen and finds that immunity can be transferred through serum but not through immune cells. This finding provides the strongest support for which hypothesis?**
- A. The Cellular Immunity Hypothesis.
 - B. The Humoral Immunity Hypothesis.
 - C. The Theory of Spontaneous Generation.
 - D. The Germ Theory of Disease.
- 16. The discovery that individuals with defective white blood cells have compromised immunity contradicts evidence stated in which hypothesis?**
- A. The Humoral Immunity Hypothesis, because it suggests immune cells are necessary for protection.
 - B. The Cellular Immunity Hypothesis, because it suggests antibodies can function without immune cells.
 - C. The Humoral Immunity Hypothesis, because it suggests immunity is mediated by blood components.
 - D. Neither hypothesis, as both suggest that immune function is essential for protection.

17. According to the passage, a major difference between the two hypotheses is:

- A.** The Cellular Immunity Hypothesis emphasizes immune cells, while the Humoral Immunity Hypothesis emphasizes soluble factors.
- B.** The Cellular Immunity Hypothesis is based on the existence of viruses, while the Humoral Immunity Hypothesis is not.
- C.** The Humoral Immunity Hypothesis states that the immune system is not necessary for fighting infections.
- D.** The Cellular Immunity Hypothesis suggests that antibodies are more important than white blood cells.

18. Based on the passage, which of the following scenarios would most strongly support the Cellular Immunity Hypothesis?

- A.** An individual is immune to a disease after receiving a blood transfusion containing antibodies.
- B.** White blood cells actively engulf and destroy pathogens in an infected tissue sample.
- C.** Immunity is transferred between individuals through serum injections.
- D.** Antibody levels rise in response to vaccination without an increase in immune cell count.

Passage (IV) :**Figure (1) Types of Parthenogenesis**

Parthenogenesis is an asexual reproductive process where an embryo develops from an unfertilized egg. It occurs in plants, invertebrates like insects and crustaceans, and some vertebrates, including reptiles, amphibians, and birds. However, it is absent in mammals due to their need for genetic contributions from both parents.

It can be classified into haploid and diploid parthenogenesis based on the ploidy of the offspring. Haploid parthenogenesis produces offspring with a single set of chromosomes (n) and is commonly seen in bees, ants, and wasps, where haploid males (drones) develop from unfertilized eggs. These offspring often have limited adaptability due to low genetic diversity.

Diploid parthenogenesis results in offspring with two chromosome sets ($2n$) and occurs in vertebrates like reptiles and amphibians. It can occur through automixis or apomixis. In automixis, a haploid cell may either duplicate its chromosomes or fuse with another haploid cell, such as the egg nucleus combining with a polar body. This process introduces slight genetic variation. In contrast, apomixis involves egg production through mitosis, creating genetically identical offspring.

Obligate parthenogenesis occurs in species that reproduce exclusively through asexual means, producing genetically identical offspring even in the presence of males. Facultative parthenogenesis allows organisms to switch between sexual and asexual reproduction depending on conditions like mate scarcity, environmental stress, or isolation. This ensures survival in certain reptiles, insects, and fish.

Parthenogenesis enables reproduction without a mate, which benefits isolated populations. However, it limits genetic diversity, reducing adaptability to environmental changes. Scientists study this process for its evolutionary significance and its potential applications in reproductive biology.

Question numbers 19 to 25 are related to Passage IV.

- 19. Referring to figure (1) and the passage, which of the following statements is correct about parthenogenesis?**
- A. The new individuals develop only from haploid eggs.
 - B. The new offspring develop from unfertilized female gametes.
 - C. Only males are produced from unfertilized eggs.
 - D. Both males and females could be produced from haploid eggs.
- 20. Which of the following is correct about individuals produced by haploid parthenogenesis?**
- A. Their body cells are copies of their mothers' body cells.
 - B. They are produced from eggs that are produced by meiosis.
 - C. They have more genetic diversity than their mothers.
 - D. They could be haploid males or females.
- 21. What is the chromosomal set of the cell used in diploid parthenogenesis?**
- A. Haploid only.
 - B. Diploid only.
 - C. Haploid or diploid.
 - D. Automixis or apomixis.
- 22. Referring to the passage and figure (1), which of the following is not one of the mechanisms of automixis parthenogenesis?**
- A. Production of a diploid gamete.
 - B. Chromosomal duplication.
 - C. Fusion with an oocyte.
 - D. Fusion with a polar body.

- 23. Which of the following is common between apomixis and automixis parthenogenesis?**
- A.** The chromosomal set of the egg used in the process.
 - B.** The level of genetic diversity in the offspring.
 - C.** The type of division used in producing gametes.
 - D.** The number of parent individuals involved in the process.
- 24. Which of the following conditions will force the obligate parthenogenesis species to switch from sexual reproduction to parthenogenesis?**
- A.** Mate rarity only.
 - B.** Isolation and environmental stress.
 - C.** Environmental stress, mate scarcity or isolation.
 - D.** None of the mentioned conditions.
- 25. Which type of parthenogenesis achieves more genetic diversity than others?**
- A.** Haploid parthenogenesis.
 - B.** Diploid parthenogenesis.
 - C.** Automixis, diploid parthenogenesis.
 - D.** Apomixis, diploid parthenogenesis.

END OF BIOLOGY SECTION

Earth Science Section (Questions 26 – 50)

Passage (1) :

Global warming is a term used for the observed century-scale rise in the average temperature of the Earth's climate system and its related effects. Scientists are more than 95% certain that nearly all global warming is caused by increasing concentrations of greenhouse gases (GHGs) and other human-caused emissions. Our atmosphere is getting hotter, more turbulent, and more unpredictable because of the “boiling and churning” effect caused by the heat-trapping greenhouse gases within the upper layers of our atmosphere as shown in

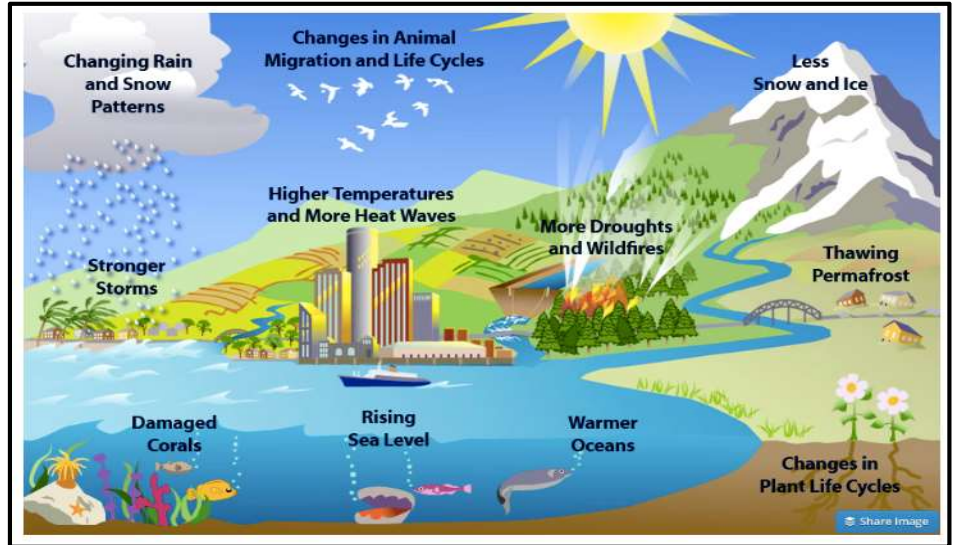


Fig. 1. Earth as a complex interrelated system.

Figure 1. With each increase in carbon, methane, or other greenhouse gas levels in the atmosphere, our local weather and global climate are further heated, and “boiled.” There are several key greenhouse gases to consider: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and so-called f-gases (mainly hydro- fluorocarbons, chlorofluorocarbons, and other fluorinated gases), as shown in Figure 2.

It's not just CO_2 , because of our greenhouse gas emissions, carbon dioxide gets most of the attention, and for good reasons. It represents about 76% of our greenhouse gas emissions each year. And the lion's share of it comes from burning fossil fuels, including our use of oil, coal, and natural gas as shown in Figure 3. That's why a lot of the focus on climate change solutions is centered on replacing fossil fuels — it causes about 62% of the problem. But a lot of carbon dioxide, and other greenhouse gases, *aren't* generated from fossil fuel combustion, and we need to look at those too.

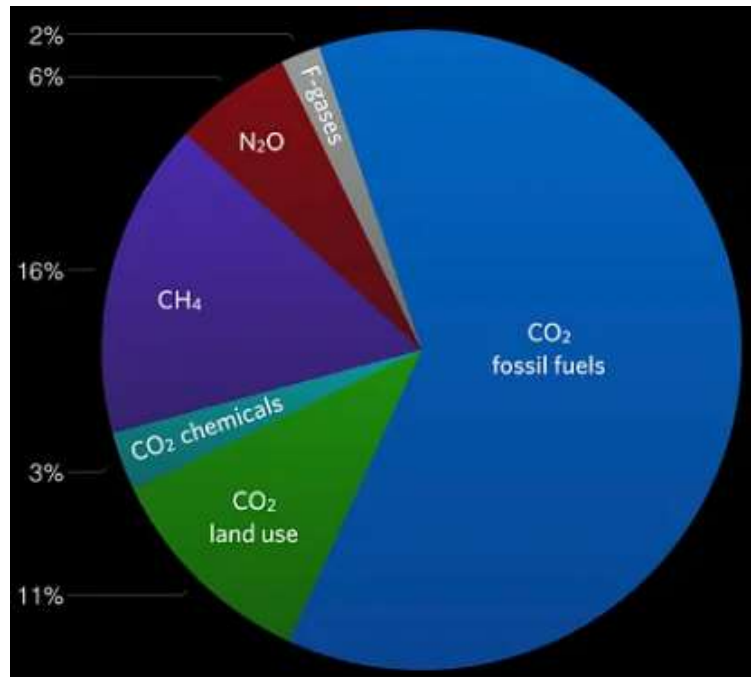


Fig. 2. Greenhouse gas emissions

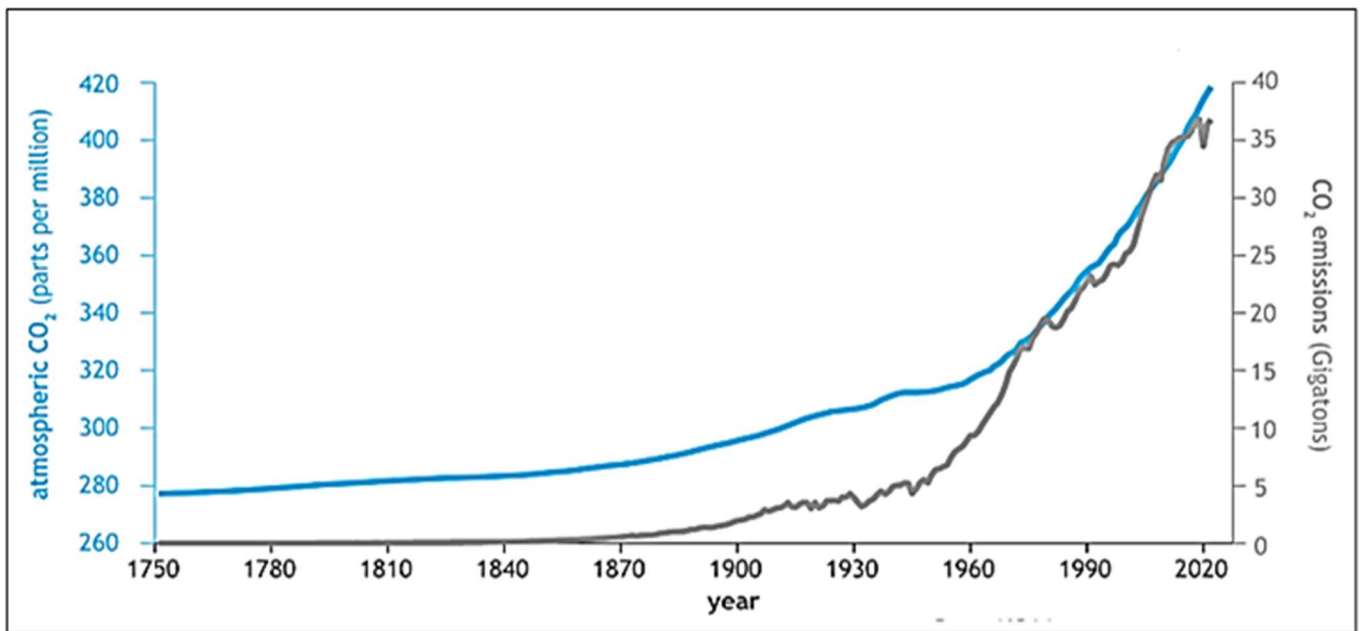


Fig. 3. Historical global annual atmospheric carbon dioxide compared to CO₂ emissions (1750-2020)

26. According to Figure 1, which of the following is NOT from the consequences of global warming?
- A. Rising sea level.
 - B. Flourishing corals.
 - C. Stronger storms.
 - D. Drought and wildfire.
27. According to Figure 1, Which of the following is a major consequence of global warming?
- A. Increase in polar ice caps.
 - B. Decrease in sea levels.
 - C. More frequent extreme weather events.
 - D. Reduction in greenhouse gases.

- 28.** According to Figure 2, Which of the following gases is NOT responsible for global warming?
- A. CO₂
 - B. CH₄
 - C. N₂O
 - D. SO₂
- 29.** According to Figure 2, the percentage of CO₂ from burning fossil fuels is:
- A. 3 %
 - B. 11 %
 - C. 62 %
 - D. 76 %
- 30.** According to Figure 2, which of the following major pollutants from natural sources have the lowest worldwide emissions (by weight)?
- A. Fluorinated gases.
 - B. Nitric oxide.
 - C. Carbon monoxide.
 - D. Methane.
- 31.** According to Figure 3, between 1960 and 2020, the annual atmospheric concentration of CO₂ rose by:
- A. 140 ppm.
 - B. 100 ppm.
 - C. 60 ppm.
 - D. 20 ppm.

Passage (2) :

Ernst Freiherr Stromer von Reichenbach was born in Germany on June 12, 1870 (Fig. 1). In 1893, he began to study geology and paleontology at the University of Munich.

He later became a vertebrate paleontologist at the Paläontologisches Museum in Munich and an expert on fossil fish and mammals. Until 1901 he traveled to Africa, more specifically to El Fayum, a fossiliferous location discovered by George August Schweinfurth, a German botanist. The place contains fossil mammals from the Eocene-Oligocene boundary.

He arrived at the Bahariya Oasis on January 11, 1911. After facing some difficulties during the journey, on January 17 he began to explore the area of Gebel el Dist, and at the bottom of the Bahariya Depression, Stromer found the remains of four immense and entirely new Cretaceous dinosaurs (*Aegyptosaurus*, *Bahariasaurus*, *Carcharodontosaurus* and *Spinosaurus aegyptiacus*), along with dozens of other unique specimens.

With the help of Richard Markgraf (1856-1916), Stromer excavated numerous remains of dinosaurs, snakes, turtles, marine reptiles, and crocodiles. The most famous of all Stromer's discoveries was the *Spinosaurus*. This gigantic land-based predator with long hind legs may have spent some of its times living in and around lake water. *Spinosaurus* is estimated to have been about 50 to 57 feet (15 to 17 m) with unusually long spines on its back that probably formed a large, sail-like structure (Fig. 2). All the Stromer's fossil collections were deposited in the Paläontologisches Museum in Munich.



Fig. 1. Ernst Freiherr Stromer von Reichenbach

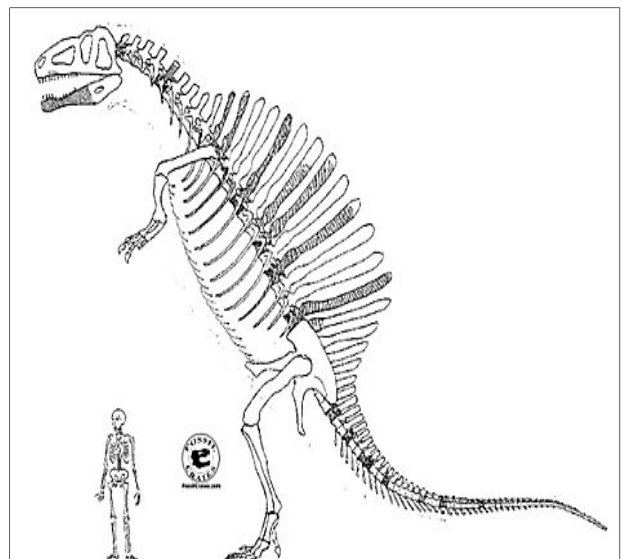


Fig. 2. Illustration of *Spinosaurus aegyptiacus* Stromer

During World War II, Stromer tried to convince Karl Beurlen -a young nazi paleontologist who was in charge of the collection- that he had to move the fossils to a safer place, but he refused to do it. Finally, on April 24, 1944, a British Royal Air Force raid bombed the museum and incinerated its collections. Of course, that was not an isolated occurrence. Between 1940 and 1944, several dinosaur fossils were destroyed in World War II battles.

Hesham Sallam, a paleontologist at Mansoura University, together with a team of students discovered a Cenomanian (Late Cretaceous) sauropod skeleton (terrestrial and feeds on plants) in the Dakhla Oasis in Egypt's Western Desert. In 2016, it was reported that over thirty dinosaur specimens had been excavated, among them titanosaurian sauropods. Based on this skeleton, the type species *Mansourasaurus shahinae* was named and described in January

2018, by Hesham M. Sallam, Eric Gorscak, Patrick M. O'Connor, Iman A. El-Dawoudi, Sanaa El-Sayed, Sara Saber, Mahmoud A. Kora, Joseph J. W. Sertich, Erik R. Seiffert, and Matthew C. Lamanna (Fig. 3). The generic name refers to Mansoura University. The specific name honors Mona Shahin, one of the founders of the Mansoura University Vertebrate Paleontology Center.

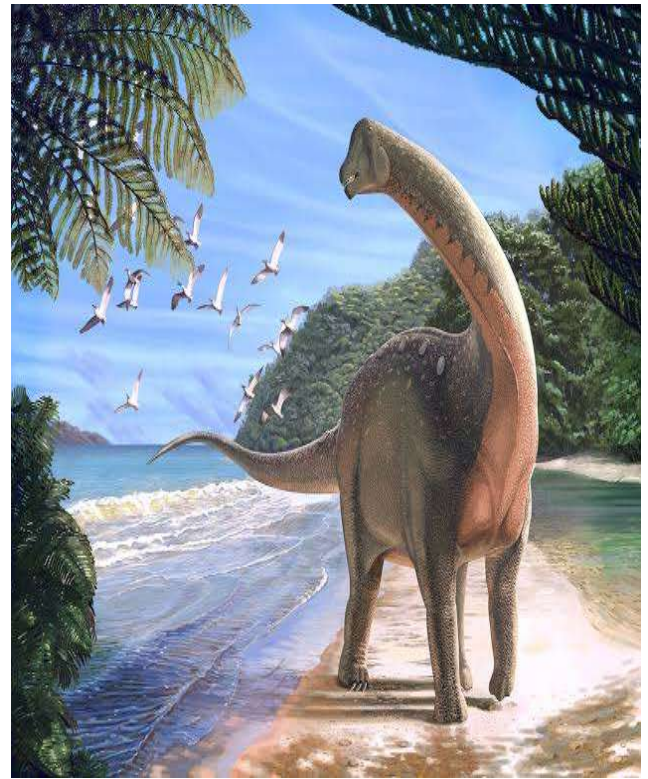


Fig.3. Illustration of *Mansourasaurus shahinae* Sallam et al. 2018

32. Ernst Freiherr Stromer was a geologist who specialized firstly in studying fossils of:

- A.** Ancient Human.
- B.** Reptiles.
- C.** Modern Apes
- D.** fish and mammals.

33. Both Ernest Stromer and Hesham Sallam are considered as:

- A. Invertebrate paleontologists.
- B. Vertebrate paleontologists.
- C. Micropaleontologists.
- D. Biologists.

34. Ernest Stromer's initial expedition to El Bahariya Oasis, Egypt took place at:

- A. 1893
- B. 1901
- C. 1911
- D. 1916

35. The most remarkable finding of Ernest Stromer in the early 20th Century from the Western Desert, Egypt is the *Spinosaurus aegyptiacus* which is characterized by:

- A. It is described as a “spine bird”, and has a very weak sail on its back, this creature naturally herbivores and is fully marine.
- B. It is described as a “spine lizard”, and has a massive sail on its back, this creature naturally preys on others and is fully terrestrial.
- C. It is described as a “spine lizard”, and has a massive sail on its back, this creature naturally feeds on plants and is fully terrestrial.
- D. It is described as a “spine mammal”, and has a massive sail on its back, this creature naturally preys on others and is fully aquatic.

36. During World War II, a British Royal Air Force attack bombed the ----- , destroying Stromer's Egyptian dinosaur collection:

- A. Geological Museum in Cairo.
- B. Natural History Museum in Berlin.
- C. Paläontologisches Museum in Munich.
- D. Mansoura University Vertebrate Paleontology Center.

37. *Mansourasaurus shahinae* is distinct from *Spinosaurus aegyptiacus* in that:

- A. *Mansourasaurus shahinae* is herbivorous, while *Spinosaurus aegyptiacus* is carnivorous.
- B. *Mansourasaurus shahinae* is carnivorous, while *Spinosaurus aegyptiacus* is herbivorous.
- C. *Mansourasaurus shahinae* is Cenomanian, while *Spinosaurus aegyptiacus* is Late Jurassic.
- D. *Mansourasaurus shahinae* is Late Jurassic, while *Spinosaurus aegyptiacus* is Cretaceous.

Passage (3) :

What is soil? It is found almost everywhere on Earth's surface. Weathered rock alone is not soil. Soil is the loose covering of weathered rock particles and decaying organic matter, called humus, overlying the bedrock of Earth's surface, and serves as a medium for the growth of plants. Soil is the product of thousands of years of chemical and mechanical weathering and biological activity. The soil-development process often begins when weathering breaks solid bedrock into smaller pieces.

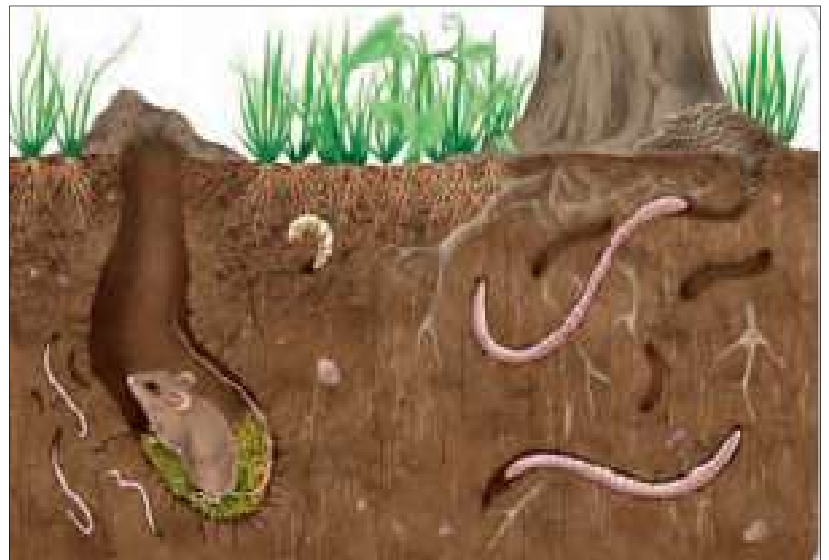


Fig. 1. Organisms in the soil change the soil's structure over time by adding nutrients and passages for air.

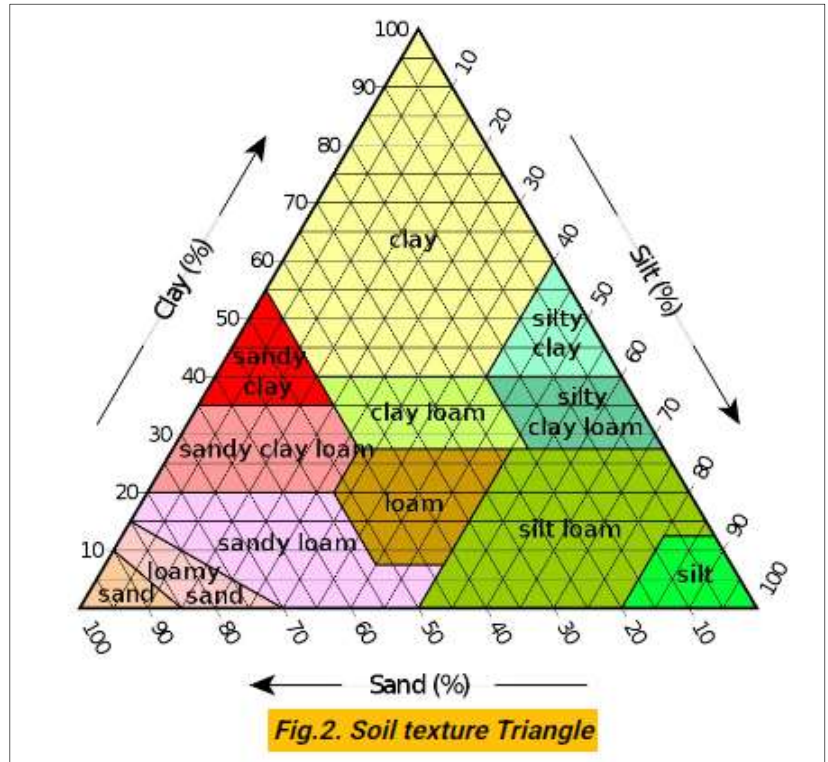
These pieces of rock continue to undergo weathering and break down into smaller pieces. Worms and other organisms help break down organic matter and add nutrients to the soil as well as create passages for air and water, as shown in **Figure 1**.

What is soil Texture? Particles of soil are classified according to size as clay, silt, or sand, with clay being the smallest and sand being the largest. The relative proportions of particle sizes determine a soil's texture, as shown in **Figure 2**. Soil texture affects its capacity to retain moisture - soil with extremely fine particles can retain water- and therefore its ability to support plant growth. Soil texture also varies with depth.

Food production takes up almost half of Earth's land surface and threatens to consume the fertile land that still remains. The global impact of farming on the environment is revealed in new maps, which show that 40 percent of Earth's land is used for agriculture.

Navin Ramankutty, a land-use researcher with Wisconsin-Madison's Center for Sustainability and the Global Environment (SAGE), posed the following question: "How can we continue to produce food from the land while preventing negative environmental consequences, such as deforestation, water pollution, and soil erosion?" One potential solution could be "precision farming." This model uses new technology to improve productivity while reducing the use of water and the application of fertilizer and other potentially harmful chemicals.

The precision system, currently being developed by NASA geoscientists, would use satellite data to help farmers decide how to use their resources with pinpoint accuracy based on the requirements of different areas of each field.



38. According to the passage & figure (1), which statement is right?

- A. The soil is just the loose covering of weathered rock.
- B. Soil is only the product of the chemical weathering of bedrock.
- C. Food production increases land fertility over time.
- D. Organisms in the soil change the soil's structure.

- 39. According to Figure (2), what would a soil that contains 20 % clay, 40 % silt, and 40 % sand be called?**
- A. Loam.
 - B. Sandy clay loam.
 - C. Silty clay.
 - D. Sandy clay.
- 40. According to Figure (2), what is the maximum amount of clay in the clay loam?**
- A. 30 %
 - B. 40 %
 - C. 50 %
 - D. 80 %
- 41. According to this passage, which statement is false?**
- A. Modern technologies are useful in farming.
 - B. Satellite data can improve farming.
 - C. Farming does not cause pollution.
 - D. “Precision farming” is a solution.
- 42. According to the passage, which one is a positive environmental consequence of farming?**
- A. deforestation.
 - B. air purification.
 - C. water pollution.
 - D. soil erosion.
- 43. The water holding capacity is the highest in:**
- A. Clayey soil
 - B. Sandy soil
 - C. Loamy soil
 - D. Mixture of sand and loam

Passage (4) :

The Red Sea Rift is a mid-ocean ridge between two tectonic plates, the African and Arabian plates. It extends from the Dead Sea Transform fault system, and ends at an intersection with the Aden Ridge and the East African Rift, forming the Afar triple junction in the Afar Depression of the Horn of Africa (Fig. 1).

The divergence between the African and Arabian plates formed the Red Sea Rift. Magnetic anomalies suggest that the spreading rate on either side of the Red Sea is about 1 cm/year. The African plate has a rotation rate of 0.9270 degrees/Ma (million years), while the Arabian plate has a rotation rate of 1.1616 degrees/Ma.

A two-stage spreading model explains the tectonic evolution in this region. The first major rift motion was seen in the lower/middle Eocene, followed by major seafloor spreading in the late Eocene and early Oligocene (see Fig. 2, for the subdivision of the Cenozoic Era). This was followed by a period of 30 Ma of no motion, during which a large amount of evaporites were deposited. After this quiet period of deposition, a new period of activity started about five million years ago. This new phase of spreading caused considerable disturbance to the sediments that were deposited, which created an unstable situation as the crust and sediments parted and the axial trough evolved. Normal faulting along the rift valley during earthquakes shows that the extensional motion is continuing.

A three-step process has been proposed for the mechanism of rifting. First, a **thermal anomaly**

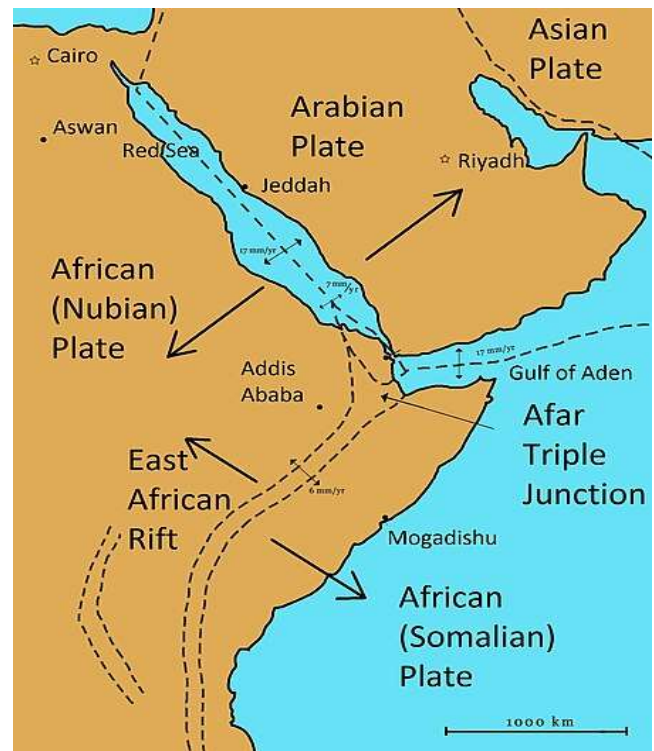


Fig. 1. Red Sea Rift between the African (Nubian) Plate and the Arabian plate

Eon	Era	Period		Epoch	Start Date (mya)
Phanerozoic	Cenozoic	Quaternary		Holocene	0.01
				Pleistocene	1.64
		Neogene		Pliocene	5.2
				Miocene	23.3
		Paleogene		Oligocene	35.4
				Eocene	56.5
				Paleocene	65
		Tertiary			

Fig. 2. Subdivision of the Cenozoic Era

developed in the mantle in the earliest stages of rifting, causing the rise of the asthenosphere and the thinning of the subcrustal continental lithosphere. There have been several mechanisms proposed to achieve this, such as convective thermal thinning (Fig. 3).

This was followed by **decompressions**, which occurred due to uplift related to the gradual stretching and thinning of the crust as rifting continued. Stretching and thinning can take place either according to a symmetrical, pure shear, extension model or due to an asymmetric, detachment-delamination model. Basaltic dykes are also injected during the stretching and thinning.

As the **basaltic injections** become restricted to a narrow axial zone. Axial propagation of the oceanic rift occurs, resulting in a continuous axis of spreading. The rift may be intersected by a shear or fracture zone, which acts as a locked zone and prevents further propagation. Zones of compression may develop.

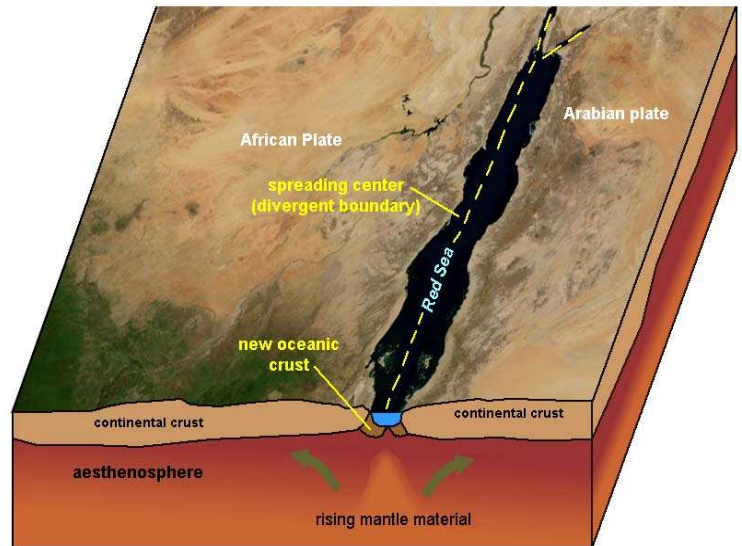


Fig. 3. A divergent boundary forming in the Red Sea area

44. According to Fig. 3, the Red Sea rift system is an example of a divergent plate boundary between:

- A.** Somalian plate and Arabian plate
- B.** Oceanic crust and Continental crust
- C.** Oceanic crust and Oceanic crust
- D.** Continental crust and Continental crust

- 45. Magnetic anomalies indicate that the spreading rate on each side of the Red Sea is around:**
- A. 1 millimeter per year.
 - B. 5 millimeters per year.
 - C. 10 millimeters per year.
 - D. 100 millimeters per year.
- 46. According to Fig. 2, the major seafloor spreading in the East African rift system has occurred:**
- A. 35-23 Ma.
 - B. 40-33 Ma.
 - C. 56-33 Ma.
 - D. 65-35 Ma.
- 47. Which of the following is NOT true for the mid-ocean ridges that occur at divergent plate boundaries, as shown in Fig. 3?**
- A. Producing enormous volcanic eruptions of basalt.
 - B. As the plates separate, a molten rock rises to the seafloor.
 - C. A new ocean floor is created as the Earth's tectonic plates spread apart.
 - D. Formation of large igneous body that has congealed from magma underground.
- 48. Which Late Miocene evaporite minerals were deposited throughout the Red Sea major seafloor spreading?**
- A. Gypsum and Anhydrite.
 - B. Rhyolite and Andesite.
 - C. Hematite and Limonite.
 - D. Quartz and Galena.

49. The NE-SW Dead Sea is an example of -----plate boundary.

- A.** Divergent.
- B.** Convergent.
- C.** Transform.
- D.** A & B.

50. The mechanism of the East African Rift System is associated with one of the following:

- A.** Creates earthquakes, island arcs, volcanic mountain ranges, and deep ocean trenches.
- B.** Thermal anomaly, decompression, injection of basaltic dykes, developing shear or fracture zones, and normal faulting along the rift valley.
- C.** The grinding action between the two plates results in shallow earthquakes, large lateral displacement of rock, and a broad zone of crustal deformation.
- D.** Loss of life and mass injuries, damage to and destruction of homes and businesses, cultural resources, utilities, and critical infrastructure and facilities.

((END OF TEST))